

SENILE CATARACT

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SENILE CATARACT

Methods of Operating

BY

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U. S. A.

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INTRODUCTION

A cataract operation by any method is considered one of the most delicate of surgical procedures, requires an immense amount of experience; and unless this experience can be mastered in some other manner than by operating upon human eyes, the loss of many eyes must be expected before dexterity can be obtained.

The author is fortunate in getting some of the world's greatest ophthalmic surgeons to present in their own way, the method they believe gives the best results in their hands.

Many ophthalmic surgeons who operate by the capsulotomy method believe the intracapsular operation is better for those of large experience than the capsulotomy operation, but feel that they must not depart from the method they have adopted on account of lack of operative material.

An honest endeavor will be made to describe a method of obtaining a technique that will enable an ambitious operator to perform any method described, and *he* will then be able to select the one which he believes will give the best visual results.

The author wishes to express his sincere thanks to the eminent men who have contributed to this effort of advancing ophthalmic surgery.

WM. A. FISHER, M. D.

31 North State Street,
Chicago, Ill., U. S. A.

May, 1923.

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Vienna, Austria

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CHAPTER I

Capsulotomy Operation

HOFERAT PROF. ERNST FUCHS
Vienna, Austria

SELECTION OF THE PATIENT

MATURITY OF THE CATARACT: If a patient with an immature cataract in one eye, has still sufficiently good sight in the other eye, I advise him to wait for the maturing, provided the better eye remains sufficiently good; but in cases where the second eye is not good enough to allow the patient to do his work, then I operate on the poorer eye at once, and when this eye has recovered useful sight, the patient may wait for the operation on the other eye until the cataract has become mature.

I do not operate on an immature cataract without necessity; but I do not shrink from operation in case of necessity.

CAPSULOTOMY AND INTRACAPSULAR OPERATION: According to my experience, the operation of an immature cataract is not more dangerous nor more liable to leave secondary cataract behind, provided that, at the operation, a large piece of the anterior capsule be removed with the capsule forceps, or that the operation be done if possible intracapsularly.

IMMATURE CATARACT: It is especially in cases of opacity of the posterior cortical substance that one is pretty sure not to leave lens matter behind, when operating before maturity.

In these cases the transparent anterior cortical substance adhering to the anterior capsule is removed; and the posterior cortical substance being disintegrated, separates easily from the posterior capsule.

RIPENING: I do not use any method for ripening a cataract. Needling of the lens in old people is either inefficacious; or, if followed by opacification and swelling of the lens, dangerous for hypertony.

Massage of the lens (Forster's operation) only acts on the anterior cortical substance, the condition of which, as above said, is irrelevant for the operation.

MONOCULAR CATARACT: If there is a mature cataract in one eye, the other eye being normal, I advise the extraction of the opaque lens.

The immediate advantage is an increase in size of the field of vision—the restoration of the binocular field; another advantage being that if later on the other eye should deteriorate, one would have to operate on a hypermature cataract, the prognosis of which is not as good as that of a ripe cataract.

Finally, a man with two seeing eyes feels much more safe than one whose mode of life is dependent on one eye.

CONDITIONS OF GENERAL HEALTH

OLD AGE: Very old age is no contra-indication, provided the patient be in tolerably good health, and that he has not at least one good eye.

I do not always put such patients into bed after the operation, but have them pass the day in an easy chair.

The same holds good for patients with respiration trouble, as for instance with emphysema, old chronic bronchitis; or with disturbances in urinating, with adenoma of the prostatic gland, or with very obese patients; in general, with all patients who feel easier and quieter when seated than when recumbent.

Heavy drinkers ought not to be required to abstain completely after the operation, else they may become delirious.

DELIRIUM: Very old people are liable to get a senile delirium after the operation if both eyes are bandaged, in which case it is better not to exclude the second eye after the operation if it still has some sight.

INTELLIGENCE: The restoration of sight by cataract operation in old people, blind for several years from cataract, has sometimes a very marked beneficial influence upon their intelligence.

DIABETES: A cataract in aged patients with diabetes as a rule is not a diabetic cataract, but a senile cataract in a diabetic person.

I first submit these patients to a treatment

for reducing the glycosuria as much as possible; I then do the operation, which, with the necessary aseptic precautions is scarcely more dangerous than in non-diabetic cases as regards infection. For me the chief danger in these cases is the coma diabeticum following the operation.

I have had no coma since allowing the patients sufficient carbohydrates with their food after the operation, and had them take some bicarbonate of sodium every day.

LOCAL CONDITIONS

CONJUNCTIVA: If the conjunctiva looks normal, I do the operation without previous bacteriological examinations and without previous test dressing.

BACTERIA: Bacteriological examinations conducted in my clinic showed that even with a normal conjunctiva, not only staphylococci, but also pneumococci or streptococci are present in the conjunctival sac in the majority of the cases.

TEST DRESSING: The test dressing is a means of increasing the number of these germs. If the conjunctiva looks diseased, a bacteriological examination is made, and the conjunctiva is treated accordingly.

In many cases even a prolonged treatment is not capable of restoring the conjunctiva to the normal state, or reducing the amount of bacteria to a notable extent. Then of course one is compelled to operate the eye as it is, and as a rule the results are not much worse than in normal cases.

LACHRYMAL SAC: The greatest attention is paid to the lachrymal sac. If there is an obstruction of the lachrymal duct, (with lachrymation, but without any secretion from the sac), I confine myself to the obliteration of the canalicula, with the galvano-cautery. If there is a discharge, I practice excision of the sac and destruction of the canaliculi with the galvano-cautery.

PREPARATION OF THE PATIENT: I prefer to do the operation in the morning after the patient has had his ordinary breakfast. In case of constipation, a laxative is given the day before the operation.

NERVOUS PATIENTS: Nervous patients take some bromide of sodium thirty minutes before operation; patients disposed to squeeze the eyelids, get an injection of a one per cent solution of novocain at the site of the facial nerve.

The patient is warned to avoid coughing and sneezing violently after the operation.

EYEBROWS AND EYELASHES: Eyebrows and eyelashes are only somewhat shortened, if they are unusually long.

ANESTHETIC: A five per cent solution of cocaine is instilled repeatedly but no mydriatic is applied.

WARD PATIENTS: The patient is operated upon an operating table and walks back to his ward after the operation. I have never seen any damage arising from this manner of caring for the patients.

PRIVATE PATIENTS: Private patients occupying a room in a sanitarium, are, as a rule, operated upon in their bed and remain there after the operation.

COVERING THE FACE: The head of the patient is covered with a sterilized linen cap, the unoperated eye being occluded.

CLEANSING THE LIDS: The lids and adjoining parts of the face on the side to be operated upon, are wiped with ether or benzin, then washed freely with soap and finally with a 1-1000 solution of sublimate of mercury.

THE CONJUNCTIVA: The conjunctiva is wiped with a pad of cotton, soaked with sterile physiological salt solution in case of a normal conjunctiva, or with a 1-4000 sublimate of mercury, if the conjunctiva is not quite normal, or if the lachrymal sac has been extirpated.

The gentle wiping is designed to mechanically remove from the surface of the conjunctiva, the thin layer of mucous which always covers it and which includes dust and germs. The same liquids serve to very freely rinse the whole conjunctival sac. Then the face of the patient is covered with a gauze veil, which has a hole corresponding to the eye.

ASEPSIS DURING OPERATION: When the operation is being performed, pads of cotton are used for wiping off blood, etc., these pads being soaked in the above liquid, but well squeezed, so that no liquid is taken into the conjunctival sac, which might penetrate through the incision into the eye.

POSITION OF THE OPERATOR: I generally sit on a high chair, at the right side of the patient.

AMBIDEXTERITY: The incision is made on the left eye with the right hand and on the right eye with the left hand.

THE ASSISTANT: The assistant stands opposite the operator at the left side of the patient.

LIGHT: Daylight is preferable, coming always from the right side of the patient when operating upon the right eye and from the left side when operating upon the left eye. Where daylight is poor and for the removal of lens matter and the replacement of the iris, an electric headlight, with a strong convex lens in front and a silver plated concave mirror on the back, is held by the assistant, so as to concentrate the light on the eye.

A mouth mask is used, but no gloves, taking care not to touch the eyeball with the fingers, but only with the instruments. These, including the knife, are sterilized by boiling in a weak solution of carbonate of sodium for three minutes.

No instrument is introduced a second time into the eye, without being sterilized.

LID CONTROL: No speculum is used during the operation, the assistant separating the lids, but letting them loose between the various acts of the operation. This is much more agreeable to the patient than a speculum, but requires a well-trained assistant.

UNRULY PATIENTS: In the case of a very unruly patient, who squeezes his eyelids very forcibly, a Desmarres retractor is used by the assistant for the upper lid.

INCISION: A narrow Graefe knife is preferred to a broad one, the former facilitating a slight turning of the knife, if its direction has to be somewhat corrected during the cutting.

The incision comprises the upper third of the cornea and is situated behind the limbus, as near as possible to it, so as to get a small conjunctival flap. During the incision the eye is secured by fixation forceps.

AGED PATIENTS: In aged patients with a frail conjunctiva a bifurcated forceps is used, which grasps the conjunctiva near the limbus in two places, below and to the temporal side, and below and to the nasal side. In this manner the conjunctiva is not so easily lacerated and rotary movements of the eyeball at the moment of the puncture are made impossible. During the rest of the operation, no more fixation is used.

CAPSULOTOMY: The second stage of the operation is the removal of a portion of the anterior capsule of the lens. If the iris has prolapsed after the incision, it must be replaced before introducing the capsule forceps. With this, as large a piece of the capsule is grasped as the width of the pupil allows.

If the capsule is tough, then by some slight movement of the forceps sideways, the suspen-

sory ligament of the lens may be ruptured, and the lens extracted within the capsule, otherwise only a large piece of the capsule is removed.

LENS DELIVERY: The third stage is the delivery of the lens. This is done by slight pressure, with the lower lid against the lower part of the eyeball, corresponding to about the lower limbus. If the lens, when coming out through the wound, should catch against the upper lip of the incision, this lip ought to be gently depressed with Daviel's curet, or with a spatula.

IRIDECTOMY: The fourth stage is the iridectomy. For this purpose the iris has to be replaced in its normal position, if it has become engaged in the wound. Then with the iris forceps, a small fold is grasped at the root, pulled out of the wound, and only the apex of this fold is snipped off, with the DeWecker scissors so as to effect a small buttonhole coloboma at the periphery of the iris. The iris is replaced and if there is still some lens matter in the eye, it is removed by gently massaging through the lower lid; the remnants of the lens then pass out of the eye, partly through the coloboma, partly through the pupil.

IRIDECTOMY: Finally a full iridectomy is made in cases in which the highest degree of safety is desired, as in patients with only one eye.

A complete iridectomy is performed after the incision and before the introduction of the capsule forceps in cases in which there is danger of escape of vitreous; or in the case of an eye

with a tremulous lens, with high myopia; or in cases in which a quiet behavior after the operation is not to be expected, as in very aged, very obese, very unruly patients, or those with a bad cough, enlarged prostate, etc.

PRELIMINARY IRIDECTOMY: A complete iridectomy is made some weeks previous to the extraction, only in complicated cases, as for instance with hypertony, or posterior synechiae, etc.; but not in uncomplicated cases, except when necessary for the sake of safety.

BUTTONHOLE IRIDECTOMY: There are cases in which an operation with a buttonhole iridectomy was intended, but could not be carried through, because the pupillary margin of the iris did not give way sufficiently to allow the lens to pass through the pupil. In such cases a full iridectomy is required before the delivery of the lens.

IRRIGATION: In my clinic at Vienna, the anterior chamber is not irrigated.

CONJUNCTIVAL FLAP: The conjunctival flap is stroked down and the eye bandaged.

BANDAGE: A small piece of gauze and over it a pad of cotton, both sterilized, are applied on the closed eyelids and fastened with a strip of adhesive plaster; over the whole a wire gauze or an aluminum shield is placed. No mydriatic or myotic is instilled immediately after the operation.

AFTER TREATMENT: After the operation the patient is led to his bed, where he remains for

the next 24 hours. The room is not obscured, but care is taken that the patient should not face the window. He may lie on his back or on the non-operated side, and sit up now and then for a time, supported by a back rest, and receive soft food for three to four days.

The morning after the operation the patient is allowed to spend the day sitting in an easy chair; the non-operated eye is left open and the operated eye dressed, by gently mopping the lids with a 1-4000 solution of sublimate.

TIME IN HOSPITAL: If the eye is alright, nothing is instilled; many cases are dismissed after the usual delay of fourteen days, without having received a drop of atropin.

IRRITATION AFTER OPERATION: Atropin is applied, if there are symptoms of irritation, or remnants of lens matter.

INCARCERATION OF THE IRIS: If the iris should be found to be engaged in the wound, the patient is taken at once to the operating table, the eye is cocainized and the iris excised.

PROLAPSE OF THE IRIS: With a buttonhole iridectomy, a prolapse of the iris scarcely ever occurs.

DAILY DRESSING: The dressing is removed every morning, some pure vaseline being applied to the palpebral fissure externally, if the lids have been found sealed together. The patient is allowed to walk up and down the ward but is warned not to stoop.

BANDAGE OMITTED: Six days after the operation the bandage is laid aside and during the day a pair of dark goggles worn; during the night the shield is worn without any dressing under it. If the wound is not solidly closed, or the aqueous chamber still shallow, the shield is worn during the day.

VIENNA CLINIC: In my clinic in Vienna, about five hundred cases of senile cataract have been operated every year, partly by myself, partly by the assistants.

STATISTICS: Statistics kept by Dr. Lindner, of the cataract cases operated by myself during the last years of my activity in the clinic, showed a loss of 0.5 per cent by infection. The patients coming to the clinic from all parts of the empire and many from abroad, had very often a much neglected conjunctivitis, or old trachoma and could not be kept in the clinic sufficiently long for the complete cure of these conditions, so that they had often to be operated with some discharge still existing. All these cases with conjunctival and other complications were usually operated by myself.

INFECTION: Infection following the operation was scarcely more frequent in these cases than in normal ones.

LACHRYMAL COMPLICATIONS: The only complication which nearly always becomes disastrous if not removed, is the diseased lachrymal sac.

CHAPTER II

Intracapsular Method

FACOERISIS

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Translated by A. G. Wipperf, M. D., Professor of Ophthalmology, Chicago Eye, Ear, Nose and Throat College,
Chicago, Ill., U. S. A.

- I. Evolution and critique of the cataract operations.
- II. Facoeisis and Erisifaco.
- III. The operation—its preparation and technique.
- IV. After-treatment of the patient.
- V. Operative accidents and post-operative complications.
- VI. Preparations and experiments to explain the mechanics of the operation.
- VII. Evolution of the Facoeisis.
- VIII. Preliminary examination of the patient and regulation of the Erisifaco.
- IX. Advice to the beginner.
- X. Conclusions.

I.

Formerly reclamation of the crystalline lens was practiced (Fig. 1), which freed the pupillary field of the lens, thus leaving the passage completely free for the luminous rays, without the least remains of the lesion. Treatment by this method would be ideal if the cataract, falling down into the vitreous, would not disturb the torn vitreous, producing its displacement (Figs. 2, 3, 4), its ectopia, and at the same time not acting as a foreign body, which causes irritation to the ciliary body (Fig. 5), and produces lesions which destroy the benefit of the operation, and leads to the loss of the organ.

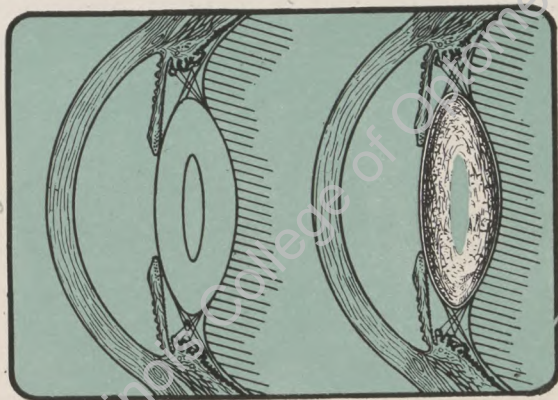


Figure 1.

Meridional sections of anterior wall of the eye, the first with a normal crystalline lens without a cataract, and the second with opaque degeneration of the cortical substance which constitutes the cataract. The unchanged nucleus is seen in its center.

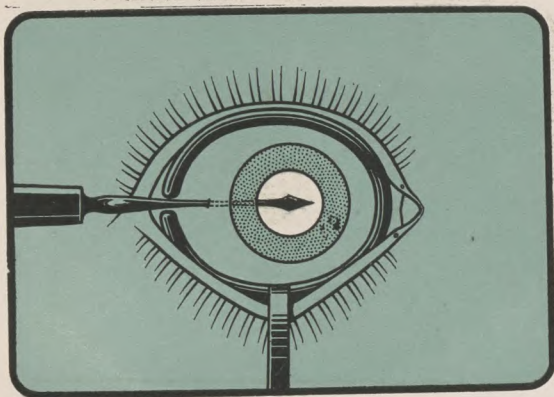


Figure 2.

A needle, stuck into the sclera two or three millimeters from the sclero-corneal margin in the outer side of its horizontal meridian enters the posterior chamber behind the iris, in front of the lens and is located in a plane above its anterior surface.

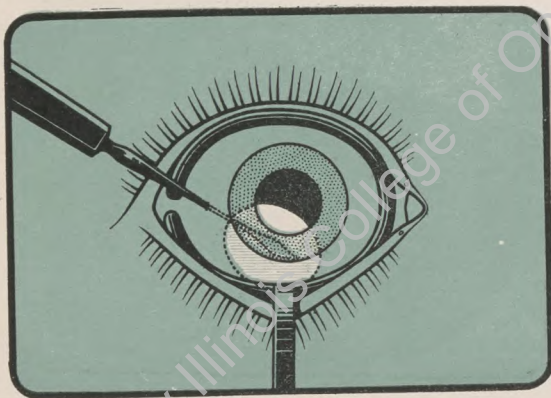


Figure 3.

By displacing the handle of the instrument upward and forwards the lens is sunk into the vitreous below and out of the way.

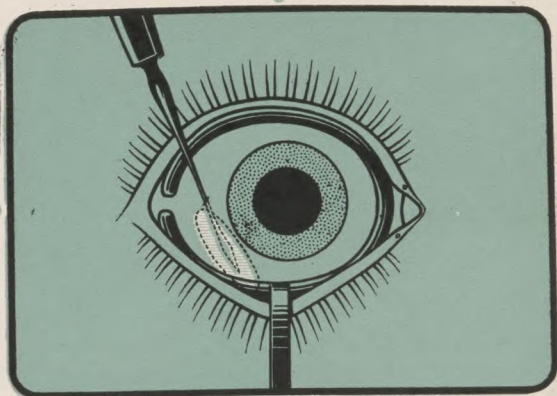


Figure 4.

The cataract which is completely displaced should be held firmly some moments and the manœuvre. Fig. 3 should be repeated as often as necessary until the lens no longer appears in the pupillary field. Notice the speculum with which the lids are held open in said operation.

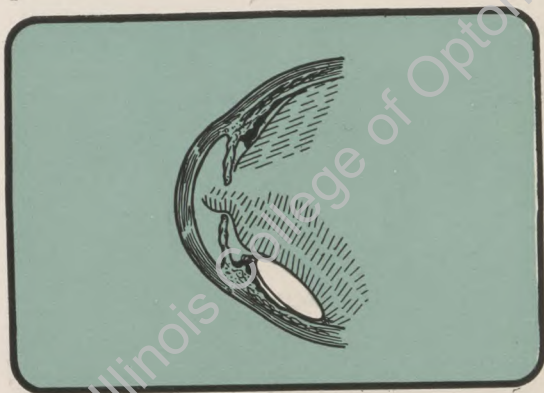


Figure 5.

The broken vitreous is seen. The vitreous is displaced into the anterior chamber and the lens has descended to the ciliary region—after the performance of the operation of reclination.

Ophthalmologists being convinced by the anatomical studies of Brisseau that the seat of the cataract was the crystalline lens, Daviel practiced its extraction—freely opening the anterior chamber and removing it from the pupil with a lancet (Fig. 6, 7). Technical difficulties and the delicacy of the capsule convert the total fancied extraction into a veritable capsulotomy, requiring at this time the now classical spoon of Daviel for the extraction of the crystalline residue. With modifications in the form, place, and size of the flap, with different methods to practice the opening of the capsule of the lens, and various procedures to evacuate from the chambers the greatest possible quantity of the degenerated substance, the operation of Daviel has reached our day without having acquired the grade of perfection that he claimed for it when he conceived it; that is, total extraction. In the classical operation with capsulotomy (Figs. 8, 9, 10, 11), we see how, after the tear with the cystotome in the capsule, the white degenerated portions of the crystalline lens fill the anterior chamber and in the cut (Fig. 12), we take into consideration the deformity which ought to allow the eye-ball to expel the hard cataractous nucleus with pressure by the spoon on the cornea. This pressure is transmitted to the vitreous and then, in order that said nucleus be expelled, it is necessary that the vitreous compress it from behind forwards and the spoon across the cornea from below upwards.

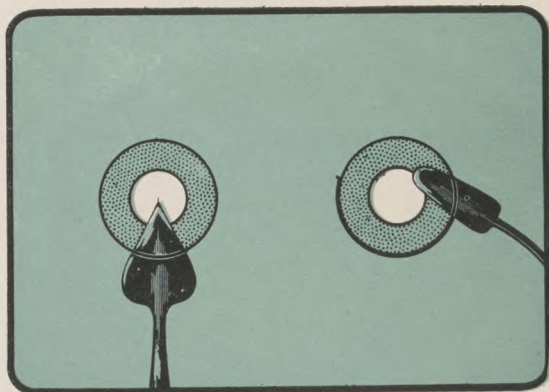


Figure 6.

An ample flap is made in the cornea by means of two keratomes; the first with a sharp point and the second with a blunt for enlarging the incision.

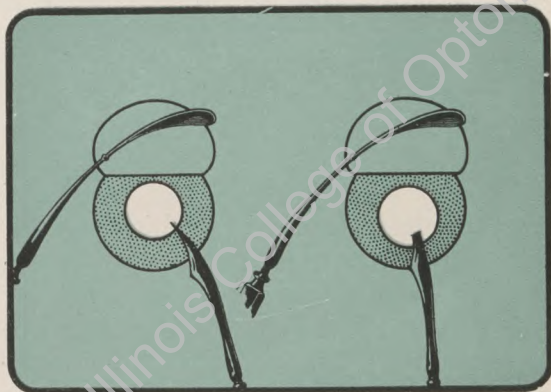


Figure 7.

With a spatula elevating the flap and with the knife needle curved and pointed, the operator pricks the cataract into the hard nucleus in order to extract it through the pupil.

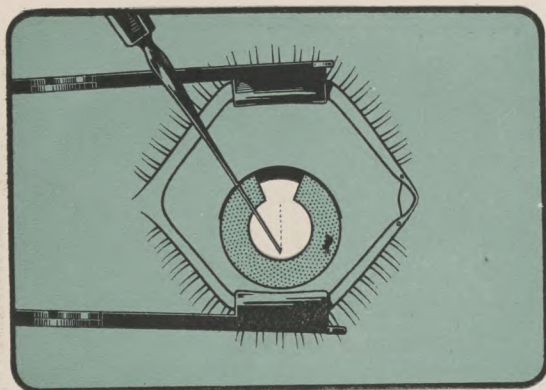


Figure 8.

The capsulotome, a cutting instrument is introduced into the deepest part of the anterior chamber and by making light pressure in withdrawing it, tears the capsule from below upwards.

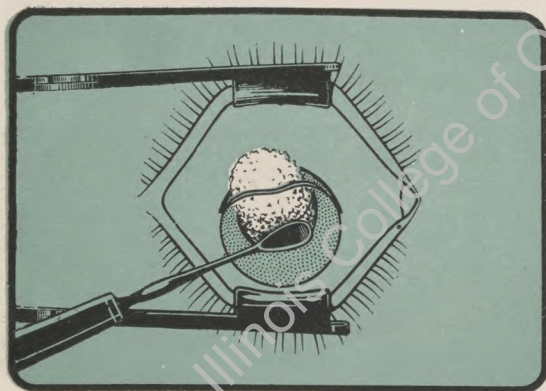


Figure 9.

By pressing downwards on the inferior part of the cornea from below upwards with a flat spoon the hard nucleus is expelled.

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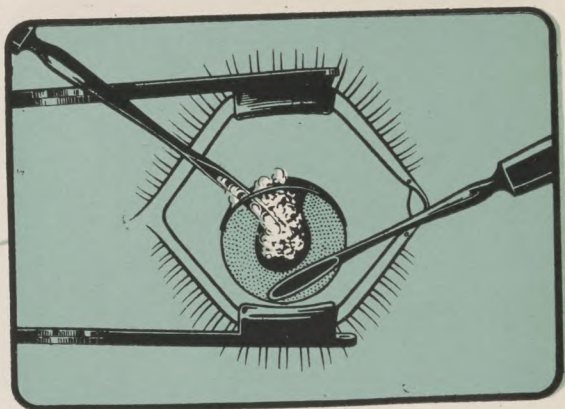


Figure 10.

With renewed pressure and by depressing the scleral lip with another spoon, we endeavor to expel the remaining cortical substance.

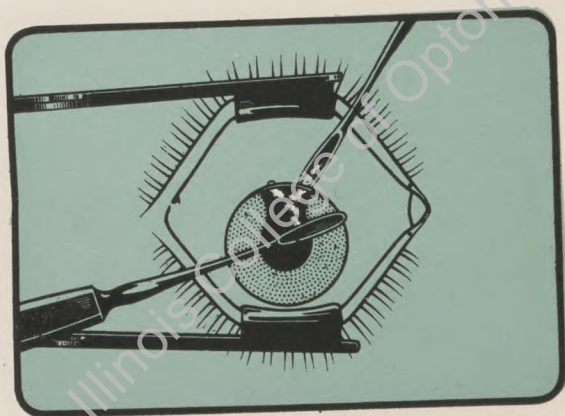


Figure 11.

Repeated maneuvers as represented in Figure 10, without however freeing the eye from the lesion, which we endeavored to remove.



Figure 12.

Left—Expulsion of the nucleus.
 Right—Expulsion of the whole mass. Notice the deformity of vitreous and cataractous material always remaining in the posterior chamber.

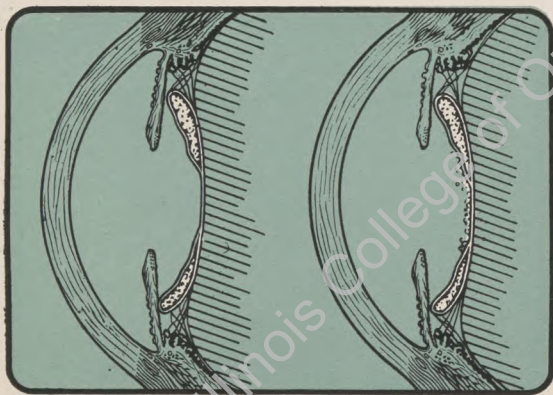


Figure 13.

After cicatrization of the incision in the cornea notice:
 Left—Adherence of the anterior with the posterior capsule and the space of the ring of Sommering.
 Right—The remains of opacity in the pupillary field.

After the procedures of expulsion, we employ pressure for the difficult toilet, and the introduction of different spoons into the anterior chamber for the purpose of extracting the greatest quantity possible of the cataract that was left behind, but finding that always a large quantity of it remained in the posterior chamber and iris angle, besides the capsule that remained almost in its entirety (Fig. 13).

These particles of toxic degenerated substance should dissolve in the aqueous and be eliminated by it. This work of dissolution and the elimination of said toxic substances cause intra-ocular inflammations that produce iritis, favor infection and contribute by opacifying the posterior capsule to the formation of secondary cataracts with more or less adhesion to the iris, posterior synechias, the indelible signs of this inflammation and consequences of the exudations produced by it. Frequently the insoluble remains of said cortical substance or portions of the capsule that were caught between the lips of the wound that failed to unite, serve as a bridge of communication between the interior and exterior of the eye, and form the road by which an iridocyclitis travels later (Fig. 14). Many have been the methods and modifications devised to perform the greatest possible total extraction; capsulotomy, iridectomy, aspiration of the masses (Fig. 15), lavage of the anterior chamber (Fig. 16), etc., etc., the innumerable procedures to prevent an incarceration from inter-

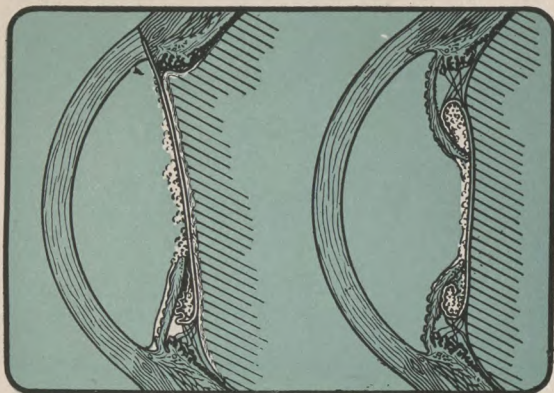


Figure 14.

Capsular inclusion accompanied by the remains of the irido-cyclitis that produces the secondary cataract enlarged by a focus of exudations, an iris thickened and adherent to the secondary cataract. The iris is most firmly adherent to the secondary cataract like the consequences of a plastic inflammation—a predisposition to secondary glaucoma.

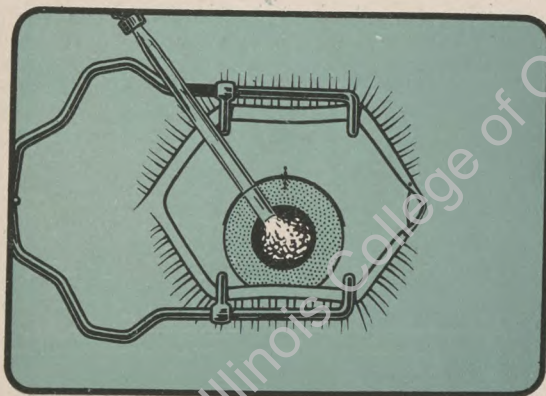


Figure 15.

With the thin canula of the aspirator of Redaro one is able to aspirate the white masses without freeing the pupillary field from the capsule and all of the cortical substance. There is danger of aspirating the vitreous.

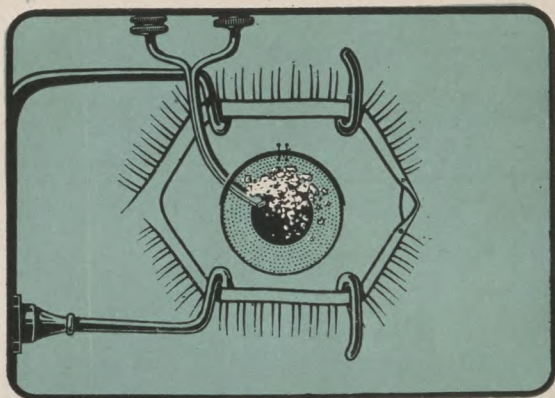


Figure 16.

A syringe having two barrels and a double canula, the one for the injection of liquids and the other to aspirate the masses of cataractous material—a great part of which adheres to the root of the iris and posterior chamber if the suction is not very strong. If the suction is too intense serious complications may follow.

fering with perfect cicatrization such as the subconjunctival extraction (Figs. 17, 18, 19, 20) and conjunctival suture of the flap (Figs. 21, 22, 23). Nevertheless, Ophthalmologists have never been satisfied with their work in the extraction of cataract, since in all countries they have conceived and described procedures of total extraction and there is none that has solved the problem, so sure is the conviction that exists in the minds of all today, that the capsular remains interfere with the results of the operation in the majority of cases.

These procedures of complete operation may be classified into two groups: expulsion and extraction. I shall not review all of these, since

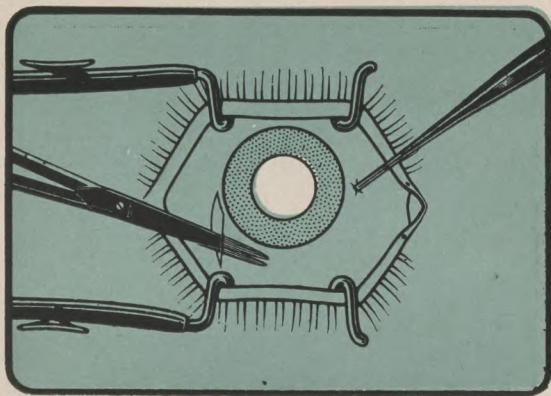


Figure 17.

With a blunt scissors—according to the technique of Zcermach, we separate the conjunctiva from the sclera in the middle lower portion of the eye-ball—by a linear incision made in the external part.

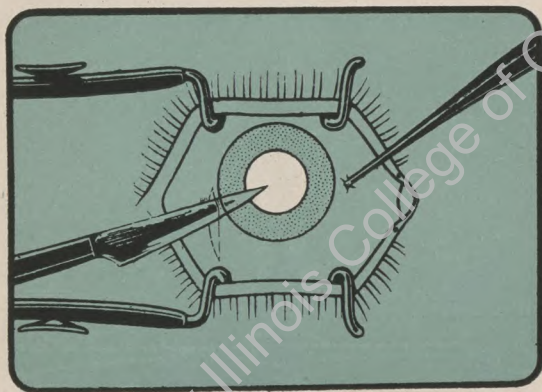


Figure 18.

With a keratome, we open the anterior chamber subconjunctivally in the same place.

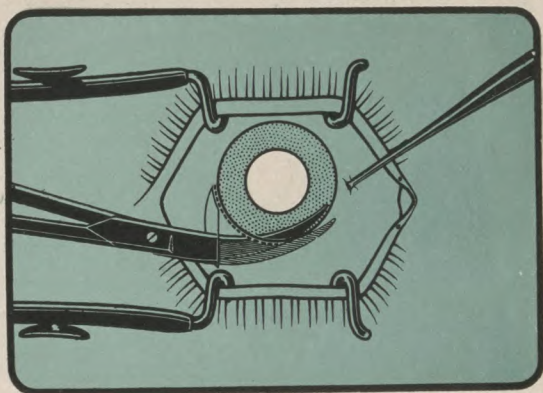


Figure 19.

Subconjunctivally with a curved scissors we complete the flap like the inferior.

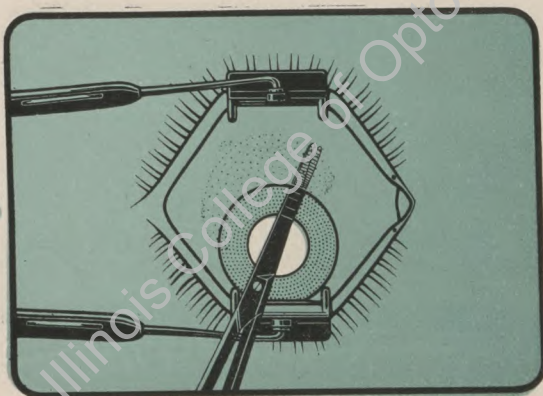


Figure 20.

Van Lint dissects the conjunctiva in the middle superior part of the eye-ball stopping at the limbus.

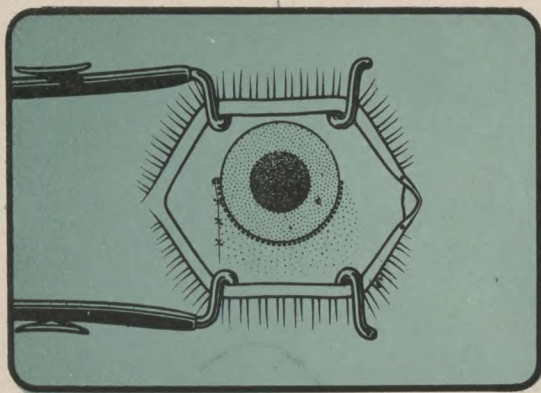


Figure 21.

Finishing the steps of capsulotomy and extraction of the cataract, we suture the conjunctiva—obtaining in this manner perfect conjunctival apposition; yet all the maneuvers make the operation more difficult, and we do not prevent complications due to the remains of the cataract left in the chambers of the eye.

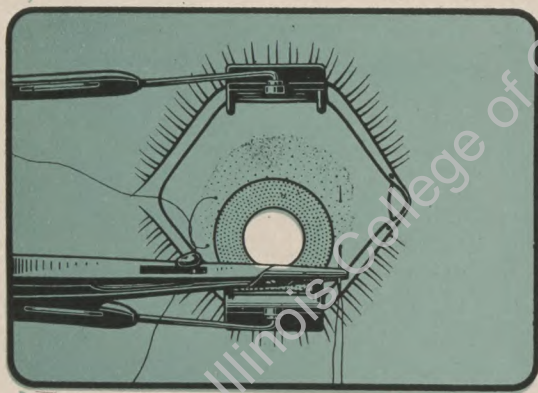


Figure 22.

After separating the conjunctiva put in two purse-string sutures, one at each end of the horizontal meridian—passing through the conjunctiva only.

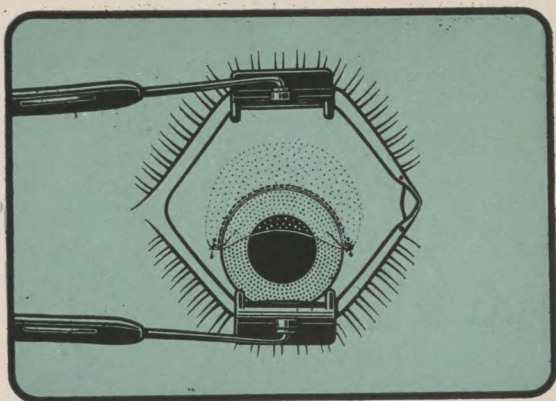


Figure 23.

After finishing the extraction tie the sutures so that the conjunctiva above the cornea comes down almost to its middle—recovering the whole flap.

my critique would be interminable and so I shall mention only those most employed. That of Smith (Figs. 24, 25, 26, 27, 28), which is, undoubtedly, the most generally used of those that pertain to the first group (total extraction by expulsion), gives magnificent results in hands perfectly instructed by him, although it is attended with the difficulty that is often present even if there is no hernia of the vitreous, that the vitreous is deformed and dislocated, and the ciliary region becomes traumatized by the slow stretching that causes the fibres of the zonula to break. These difficulties are common to all the procedures of total extraction by expulsion, since with them the cataract comes to the exterior pressed forward by intra-ocular means which transmits in all directions the pressure exercised

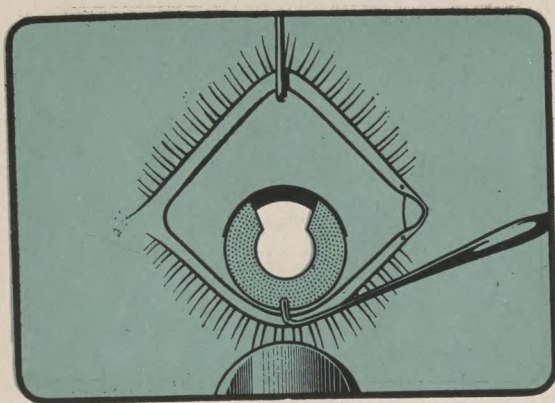


Figure 24.

Notice the position of the strabismus hook on the cornea across which the eye is compressed.

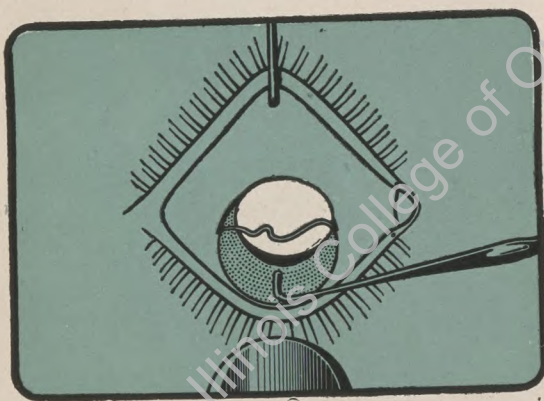


Figure 25.

By increasing the pressure, the wound is opened and the border of the crystalline lens appears in it.

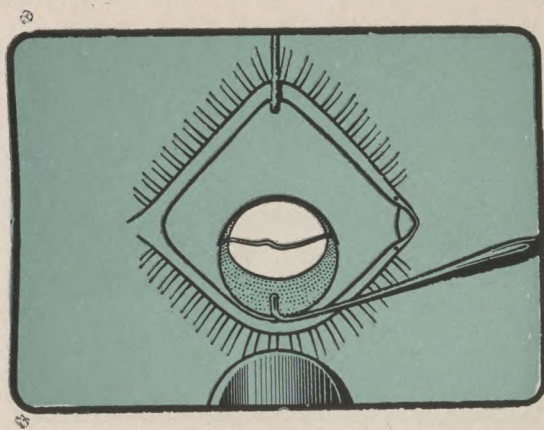


Figure 26.

Notice how the pressure deforms the cornea and how the cataract appears on its exterior.

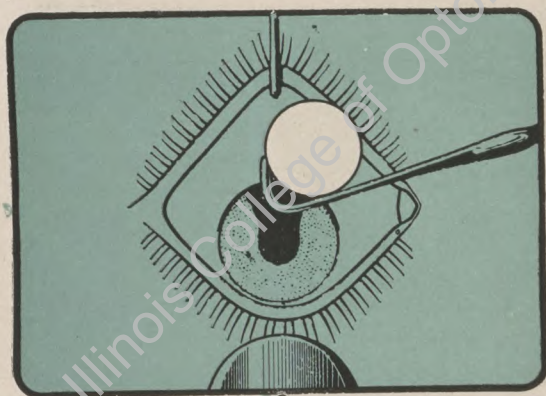


Figure 27.

The cataract being almost expelled, is stretched with a strabismus hook to break the zonula.

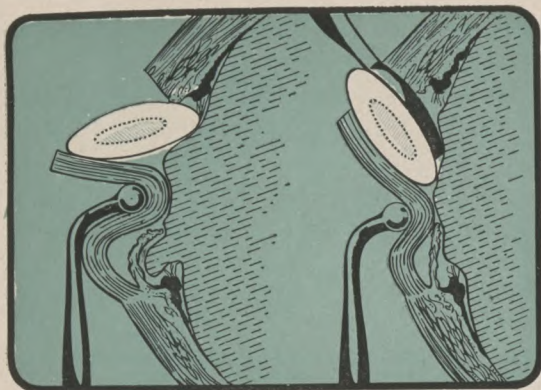


Figure 28

Cuts showing: On the left the deformity that the vitreous and cornea suffer. On the right the facility of breaking the hyaloid membrane with a spoon which we employ.

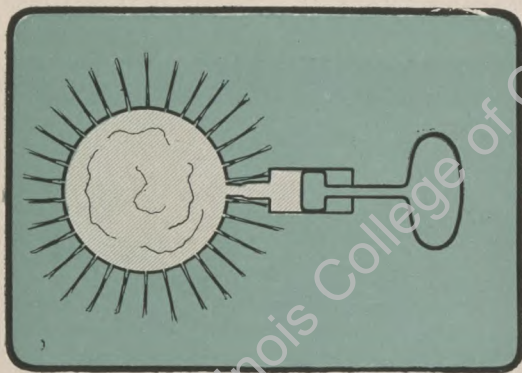


Figure 29.

The figure represents the classical experiment, namely, that in liquids a pressure at one point transmits itself to all points with equal force. A hollow sphere with multiple openings on its surface is filled with water and by making pressure through one of these openings with a plunger, one sees water come out through all the others with equal force.

on the surface of the eye according to the principle of Pascal (Fig. 29).

In the second group we encounter as a type, all the procedures that seize the lens by its anterior surface, by means of a needle, a hook, or a pincette (Figs. 30, 31, 32), extracting by drawing it anteriorly after having tried to break the zonula with movements on the side in different directions. The forceps, the hook, or the needle has a tendency to rupture the capsule and convert the operation into a capsulotomy; and in the cases that resist the displacement from the side, there are those that produce with the lens a rupture of the zonula, causing the lens to be compressed in some parts of the ciliary region, and traumatized on the opposite side by the stretching produced by the traction of the zonula

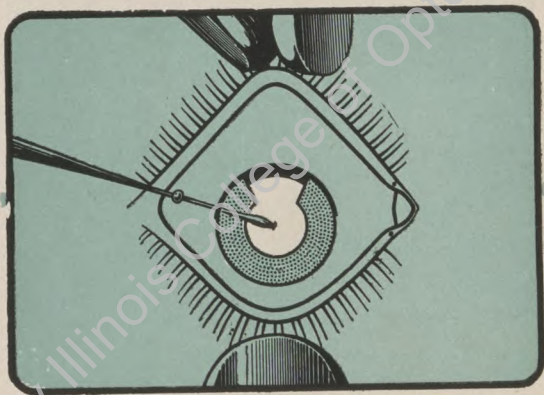


Figure 30.

Horfoed, imitating Daviel, transfixes the lens with a needle.

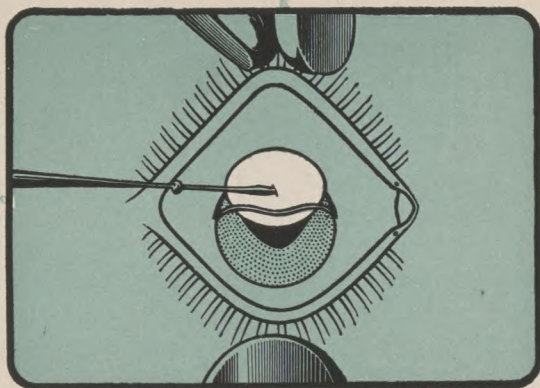


Figure 31.

In cases of hard cataract, total extraction succeeds only and invariably with an iridectomy.

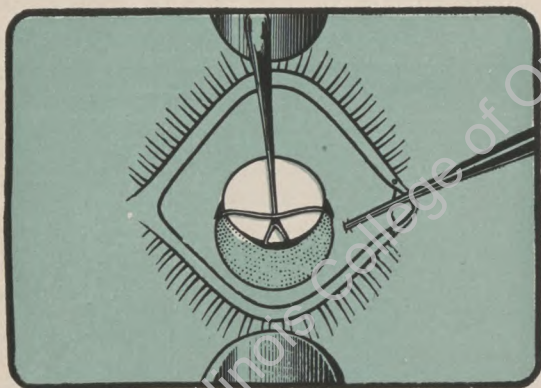


Figure 32.

Orlando Pes with a twin blunt hook passed behind the iris, holds the inferior border of the lens that he withdraws gently when the superior portion comes out, and effects a total extraction; but with greater danger of a hernia of the vitreous from the pressure that he uses on the inferior border of the lens.

fibres before breaking them. Moreover, there are those who believe that the posterior surface of the convex lens is in intimate contact at all points of its surface with the anterior surface of the vitreous from the identical concavity and the perfect juxtaposition of the two surfaces producing an adherence that renders it impossible to extract the lens by drawing it directly forward as it would be impossible to separate the two surfaces (Fig. 33), by stretching in the direction of the arrows "A"; it would be necessary to disarticulate the surfaces, to produce a movement of leverage as in "B", movement giving the smallest point of fulcrum that is represented by the forceps or a needle, an effect impossible to execute, although some authors depress, compressing the scleral lip of the wound with a spoon (Figs. 34, 35), and deforming the patellar fossa in order to break up this adherence, due to the exactness of the two surfaces; others compress the inferior part of the cornea (Fig. 36), and by this pressure, procure deformation of the patellar fossa. It is clear that these two last modifications make a combination of extraction and expulsion by which one produces the above defects. The idea of Kuhns to cut the zonula with a cutting instrument and extract the cataract would be ideal if a cutting instrument did not have to be manipulated blindly in so delicate a region and one of such small dimensions as the posterior chamber (Fig. 37). The zonulatome proves to be an useless instrument in practice.

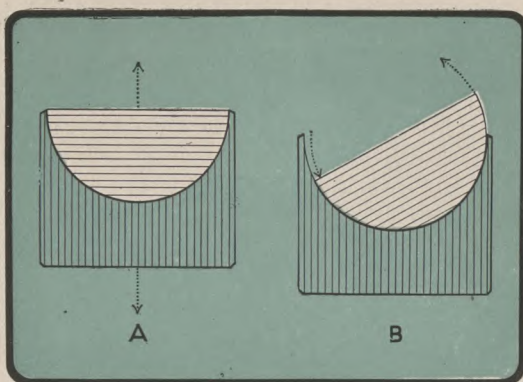


Figure 33.

In "A"—by making pressure in the direction of the arrows, adhesion prevents us from separating the convex lens from the concave, if the two have identical curvature. It is necessary to disarticulate them as in "B" to accomplish a movement of rotation.

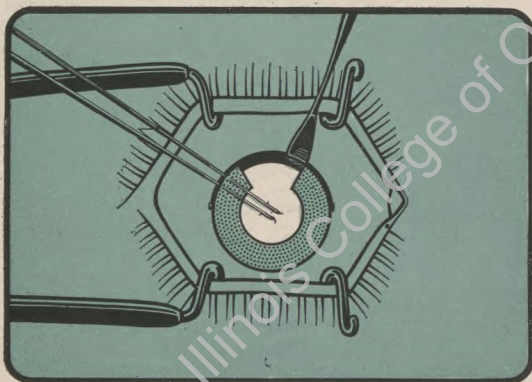


Figure 34.

Torok, after transfixing the anterior surface of the lens with a pincette, depresses the scleral lip with a spoon.

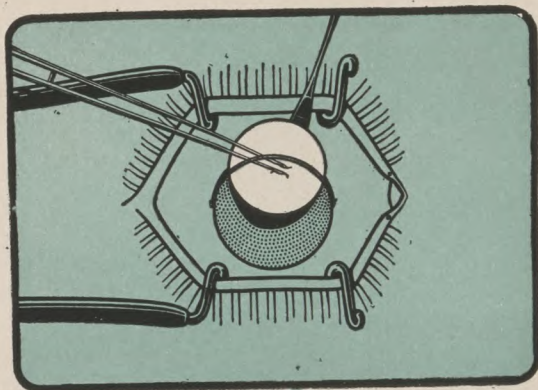


Figure 35.

Notice how the entire cataract comes out if the capsule has resisted the pinching of the pincette.

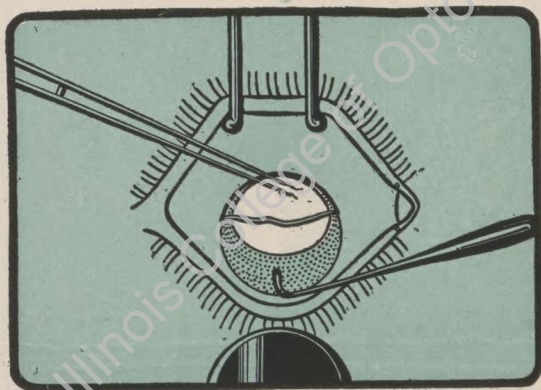


Figure 36.

Verheef compresses the cornea like Smith with the least pressure—and at the same time withdraws the cataract with a pincette.

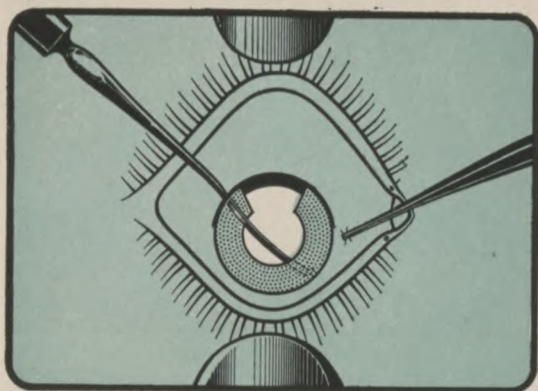


Figure 37.

With a zonulotome we cut the zonula all around the crystalline lens. Notice the danger that said maneuver entails—working with a cutting instrument in the dark within the posterior chamber.

Considering the extremes in the methods that I wish to criticise, it is easily seen that the defect of these techniques consists in leaving the remains of the lesion in the interior of the eye or in producing ectopias and traumatism in the intra-ocular organs and that the ideal method consists in cutting the zonula and drawing the entire cataract with gentleness to the exterior without either pressure, stretching, or violence. (Fig. 38.)

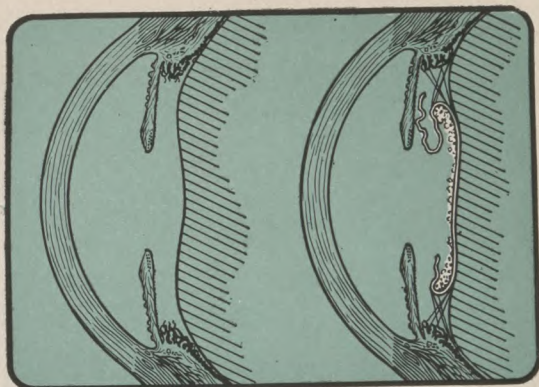


Figure 38.

Comparison between the condition of the region of the lens after Facoerisis and after the classical operation. After the former no part of lens, capsule, or of degenerated substance remains. Note at the bottom of the pupil the normal limit of vitreous humor. In the second figure a secondary cataract is seen.

FACOERISIS AND ERISIFACO

Facoerisis consists in drawing the crystalline lens by its anterior surface, separating it mechanically without either traction or violence of the zonula, and extracting it completely, out of the eye-ball, without having produced ectopias or traumatism to the intra-ocular structures. The instrument employed, called the Erisifaco, is nothing more than a pneumatic forceps and a zonulatome. Figure 39 represents a longitudinal section of the Erisifaco and of the intermittent or vibratory pump which is employed to work it. The suction cup has the capsule of adherence (1) and in (2) a canula terminating in a conical screw (3) connected with (4), to a

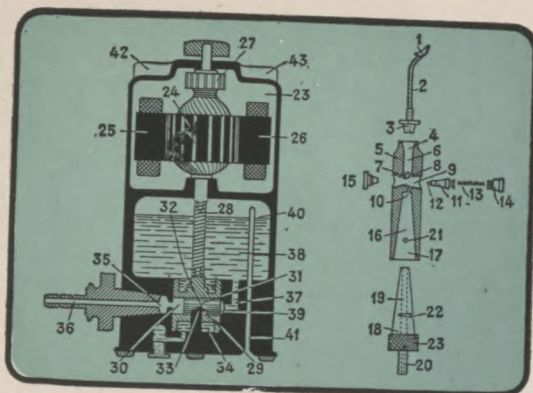


Figure 39.

A schematic cut of the pneumatic machine with vacuum vibrator and erisifaco.

distributing part (5), which has a tube (6) that bifurcates into two smaller tubes (7 and 8), which communicate with a chamber (9) in which two conical valves (11 and 15) fit and coincide on opposite sides. The latter one is capable of closing the canal (7) if it is adjusted, or to permit communication with the atmosphere, if it is not open. The valve (11) prevents communication between the channels (8 and 10), if it is adjusted, or prevents communication across the chamber (9) if it is somewhat separated from its screws to the bill of the valve (15) and said valve seat. The valve (11) has an index (12) which (11) is set below the action of a spring compression (13) held by means of a cap (14). The canal (10) communicates with another (17) which terminates in a conical widening, into

which fits the cap (18) with an internal space (19) and terminates with a small projection (20) that serves to close the tube that transmits the vacuum from the pump which we shall describe below.

When operating the pump with its intermittent suction, this vacuum is not produced in the suction cup, because the spring (13) maintains the valve (15) somewhat separated from its seat by communication with the tube, and, therefore, the canula (2) with the atmosphere, as the valve (11) is applied perfectly against its seat. It obstructs the communication between the tubes (8 and 10) and consequently that of the canula (2) with the vacuum intermittent pump.

When one wishes to establish a vacuum instantaneously in the suction cup, he closes the valve (15) which automatically compels (11) to separate from its seat on account of the threaded joint existing between said valves (15) and the threaded bill (12) of the valve (11), then said valve (15) adheres to the cataract by the force of the atmospheric pressure deforming and transmitting it by jerks to the interruptions of the vacuum produced by the intermittent pneumatic machine. When the operator wishes to suspend the effect of this vacuum, it suffices to open the valve (15), (11) closing itself. According to the physical conditions of different cataracts, it is necessary to graduate the intensity of the vacuum produced intermittently and keeping in mind that this vacuum is not abso-

lute, but just sufficient to produce a relative rarefaction of the air which the suction cup produces in its interior.

The above mentioned graduation is produced by means of an arrangement of grooves (21) and (22) placed in the cap (18), and in its conical seat (17). This regulator has been placed in some models in the eminence (36) of the pneumatic machine or in the vacuumeter contained in the vacuum. The machine is composed of two parts: the upper (23), contains the electric motor of which (24) is the induction coil, (25) and (26) the primary coils and (27) the collector. The motor carries a flexible shaft (28) at the end of which is fixed the rotary cylinder (29), which has in (30) a cylindrical perforation crossing diametrically from part to part in which lodges the piston (31), which is a solid cylindrical body capable of sliding within its case, perfectly adjusted. Said cylindrical body has in (32) a notch or fissure in which a spike (33) penetrates, fixed in the bottom of the groove (34), that serves as a coupler to the cylindrical rotary cylinder (29). When the cylinder (29) assumes rotation, the piston undergoes a movement of vacillation within its case (30), forced by the coupling existing between the fixed spike or nail (33), and the fissure (32); (35) is a tube that goes from the groove (34) to the opening (36), where there is a nozzle coupled with a rubber tube by which the force of the vacuum is transmitted to the suction cup; the orifice of

the tube (35) in the groove (34), rises to the level of the perforation (30) in which is the case of the piston (31). At the same level arises another tube (37), that opens in the groove (34) and in the upper chamber; in the opening of said tube (37) and in the groove (34), is a fissure (39) that has an extension at 45 degrees in the cylindrical wall of said groove. By working the apparatus when the piston (31) presents at the front of the orifice, this rises at a distance from the periphery of the rotary cylinder (29) and for this reason having left a space of vacuum (30), this vacuum is transmitted across the tube (35) and the coupling tube, to the suction cup in which the air is rarified, and if it is closed, its communication (7) with the atmosphere. The air that has filled the space is expelled across the fissure (39) and the tube (37) towards the chamber (38). This chamber to a certain height and all the interior portion of the apparatus contains a supply of lubricating oil for the hermetical adjustment of all the pieces, leaving a level up to 40. The air that flows out of the tube (37) up to the chamber (38), passes through the mass of oil and goes outside, through a small tube (41), which is there for that purpose. The pump operates by an electric motor (24), (25), (26), (27), of which coupling pieces are in the inside of (42), (43), producing in the rotary cylinder (29), the movements already explained by the piston (31), in such a way that repeated periods of vacuum are obtained in the tube (35), and

consequently in the suction-cup these periods being so much more frequent according to the revolutions, that the rotary cylinder may make, which condition may be graduated by the viscosity of the oil which is introduced into the pump, for the greater the resistance may be, the greater will be the resistance the motor will have to overcome, and the less will be the velocity. A perfect adjustment of the valves and cones is indispensable in this instrument for the success of the operation, for which reason it is necessary to keep the adjustments perfectly clean.

THE OPERATION: ITS PREPARATION AND TECHNIQUE

1. **OPERATING ROOM:** In the operating room the light ought to be diffuse and of little intensity, by a photophore in such a way that one may see through the cornea, the finest details in the interior of the chamber, being able in this manner to make the work of extraction the same in every instance. Assistants must not talk and only the operator should speak to the patient.

The instruments should be arranged always in the same order on a special tray at the level of the patient's neck (Figs. 40, 41), in order that the operator who finds himself placed at the head of the patient may be able to take any one of them without hesitation, never losing view of the operative field. Said instruments should be

examined with scrupulous care previously and sterilized by dry heat in a metallic box or by boiling.

Sutures are previously sterilized either in the autoclave or by boiling and are kept sealed in glass tubes full of alcohol.

The operator and his assistant should use gowns, masks and silk gloves. In a hospital service it is useful to have two contiguous operating tables, with two assistants or nurses; while one of them is occupied at one table with the operator, the other arranges the adjoining table, changing and preparing a new patient. In this way it is possible to do a large number of operations in a short time.



Figure 40.

The operator at the head of the patient, the assistant at the right, the instruments placed at the level of the neck of the patient and a fixed photophore obliquely illuminating the operative field.

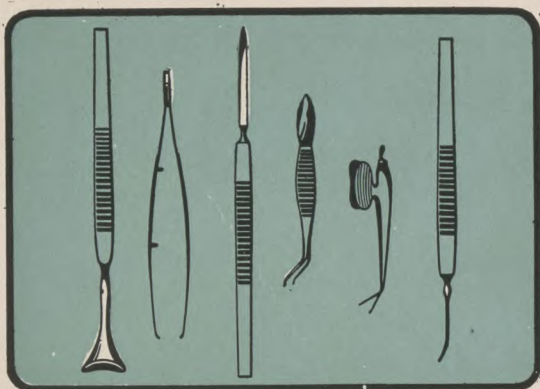


Figure 41.

- Reading from left to right—
a. Elevator of Desmarres.
b. Fixation forceps of Landolt.
c. Knife of Pannas.
d. Iris forceps of Hess.
e. Scissors of Pasheff.
f. Stilette of Daviel.

2. PREPARATION OF THE PATIENT: Before operation the skin of the lids and contiguous parts are washed with soap and water followed by an application on the eyelashes and lids of a 4 per cent solution of silver nitrate and a light friction on the ciliary border with oil containing bin-iodide of mercury. The fornices of the conjunctival sac are flushed with sterilized serum by a jet from an aseptic flask (Fig. 42), covering the lids with gauze soaked in a 1-1000 solution of hermophenyl, and between the lids is deposited a quantity of ointment containing 5 per cent of the chlorides of euphthalmine and cocain, in order to produce anesthesia and the necessary



Figure 42.

The irrigators, the syringes, and other instruments employed for washing out the fornix of the conjunctival sac, do not require the conditions of absolute sepsis nor do they need to be directly accessible.

dilatation of the pupil, which is usually obtained in most patients with one application in an hour and a half.

After the patient is placed on the operating table and the sterile field of operation exposed by uncovering both eyes, we make an injection of 1-100 novocaine necessary to produce temporary paralysis of the orbicularis, according to the technique of Vanlint and Villiard (Fig. 43) and a second flushing of the fornices of the conjunctival sac, holding the upper lid both times with forceps; instil a few drops of a collyrium containing

Chloride of euphthalmine, 0.25 grammes.
(4 grains.)

Hydrochloride of cocain, 0.25 grammes.
(4 grains.)

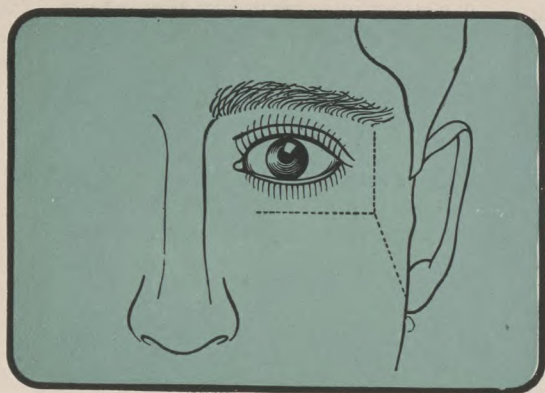


Figure 43.

Method of procedure in the three injections of Novocain—5 drachms (1:100) in order to effect complete relaxation of the orbicularis palpebrarum.

Solution of adrenaline 1-1000, 3. CC. (45 minims.)

Solution of sodium chloride, 6-1000, 3. CC. (45 minims.)

A second instillation of the collyrium is made three minutes after the first, and a third three minutes later. We wait five minutes before beginning the operation during which time the patient is requested to look up and down, and gently close the eyes.

3. **FIXATION:** The assistant, standing at the right of the surgeon with his left hand raises the upper lid with the retractor of Desmarres or Fisher; with his other hand he separates the lower lid (Fig. 44), while the surgeon takes hold of the conjunctiva and subconjunctival tissues with the forceps of Landolt, one millimeter

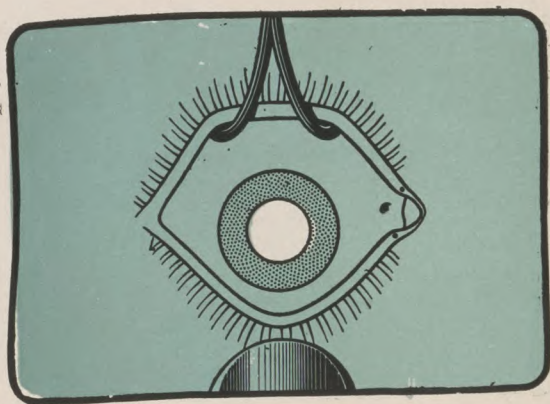


Figure 44.

The upper lid is held lightly with a hook and the inferior lid depressed gently with the thumb of the assistant.

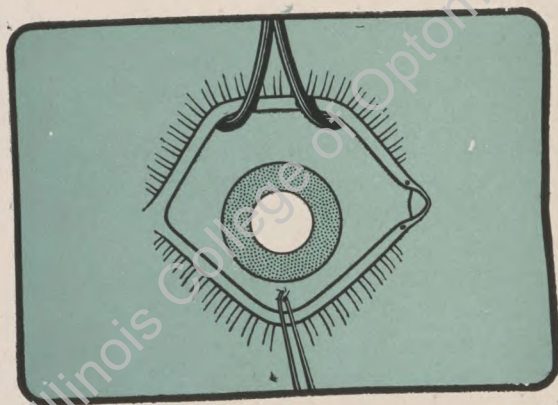


Figure 45.

The forceps of Landholt holds and fixes the conjunctiva, about 1 mm. below the sclero-corneal junction of the vertical meridian, without making pressure on the globe.

from the lower extremity of the cornea on the vertical meridian (Fig. 45), without producing any pressure on the eyeball.

The lid speculums, frequently employed, make pressure upon the eyeball and do not maintain sufficient separation of the lids from it. The fixation at the nasal extremity of the horizontal diameter of the cornea, so much proclaimed, facilitates pressure on the globe at the time of puncture with the Graefe knife.

4. SECTION OF THE FLAP: This ought to include the superior two-fifths of the cornea and cut throughout its entire extent in the sclero-corneal margin, or better yet, with a small tongued conjunctival flap in its middle third. The puncture should be one millimeter above the horizontal diameter of the cornea; Graefe's knife held like a writing pen in the right hand for the right eye and in the left hand for the left eye, (if the surgeon is ambidextrous), should traverse the thickness of the cornea in the direction of its radius of curvature (Fig. 46), keeping its blade parallel to the iris as well as ready when it enters the anterior chamber with a slow and progressive movement, to advance always parallel to the iris and the horizontal meridian of the cornea until it arrives at the point of counter-puncture which should be symmetrical to the puncture (Fig. 47), keeping in mind that on account of the corneal refraction, one sees the point a millimeter behind the sclero-corneal margin.

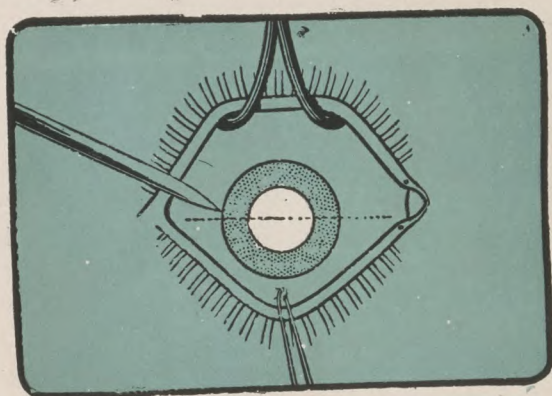


Figure 46.
Puncture.

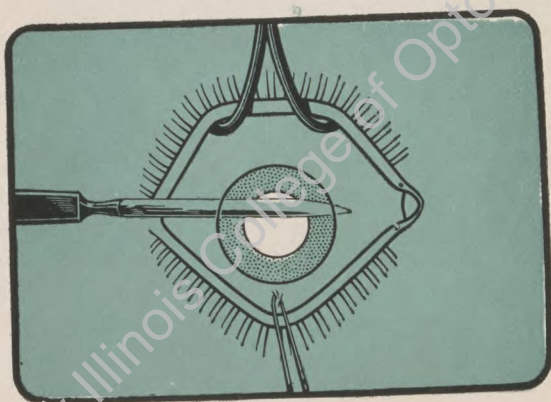


Figure 47.
Counterpuncture.

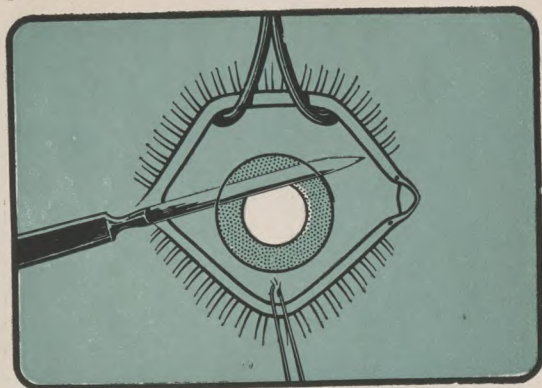


Figure 48.
Incision of the internal third of the flap.

When the knife appears at the counter-puncture still penetrating, it should move upwards cutting the internal third of the flap (Fig. 48). We then draw the instrument back in such a way that its handle is directed upward cutting the third of the flap, corresponding to the site of the puncture (Fig. 49). A little change in the horizontal plane of the blade will produce a flow of aqueous humor, shallow the anterior chamber, and will prevent finishing the flap correctly; the middle, or the last part of the incision is made by diverting the blade backward toward the sclerotic, finishing with a large conjunctival flap that is limited by directing the edge of the instrument forward (Figs. 50, 51). During the incision the eye ought not suffer the slightest displacement, or deformity, nor stretching, which is accomplished by using a perfect knife, making a

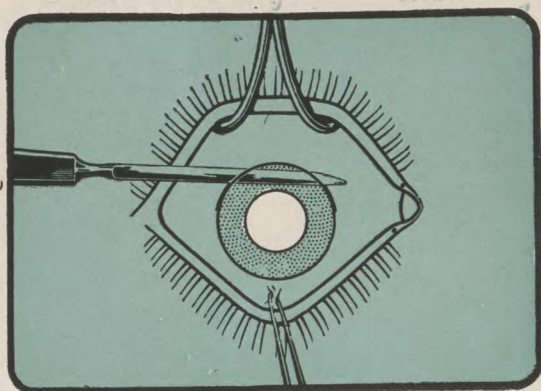


Figure 49.
Incision of the external third of the flap.

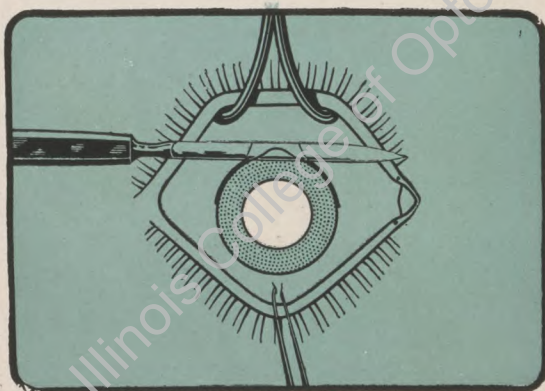


Figure 50.
Incision of the median third of the flap—with a long conjunctival flap.

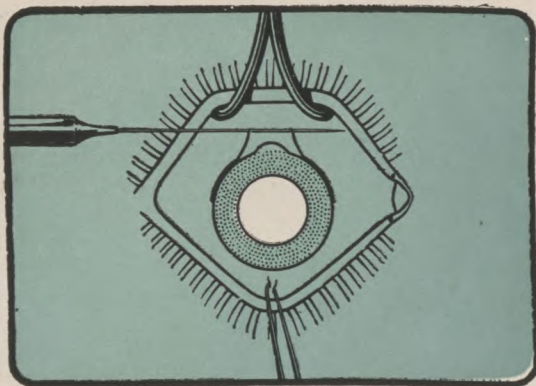


Figure 51.
End of the conjunctival flap.

radiate puncture, moving the hand with uniform care, being always careful not to make pressure with the fixation forceps. An excessive scleral flap or a section not uniform or even, or a difficult incision predisposes to accidents during the operation or post-operative complications. It is very useful to employ a suture in the conjunctival flap (Fig. 52), or better still, previously, that of Suarez de Mendoza, if the flap is purely corneal (Fig. 84).

5. IRIDECTOMY: If it is a question of a more voluminous cataract, very intumescent, an iridectomy is indicated. Without doubt this condition predisposes to incarceration of the fibres of the zonula which we have previously stated, is a disadvantage.

If we seek absolute security as to hernia of the iris by observing the advantages of simple

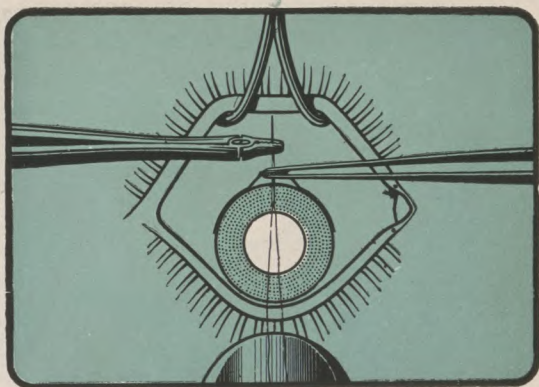


Figure 52.

The forceps hold the conjunctival—lips of the wound—in order to better apply a suture.

extraction, we buttonhole the iris, sparing the sphincter pupillae, according to the technique of Hess; by this operation a small pinched up piece is cut off in the more peripheral part of the iris with a very tiny scissors, resembling that of DeWecker, under the cornea without drawing the iris outside the wound (Figs. 53, 54).

6. EXTRACTION: At this time, no kind of fixation of the eyeball should be employed; the assistant holds the lower lid by maintaining slight separation from the eye, whilst the operator with the left hand elevating the upper lid anteriorly with the elevator (Fig. 55), asks the patient to look down; taking the Erisifaco in the right hand as I endeavored to indicate in the engraving No. 56, without making the least pressure on the

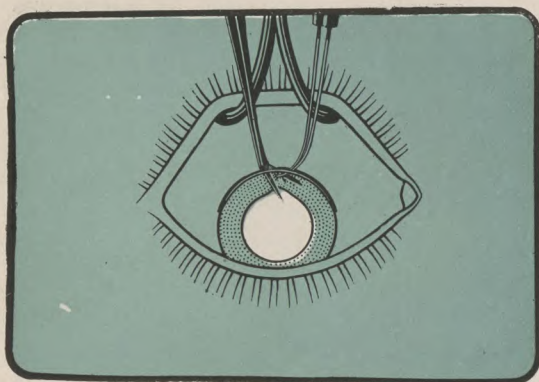


Figure 53.

Showing how the iris should be held and cut within the anterior chamber—without drawing it outside the eye.

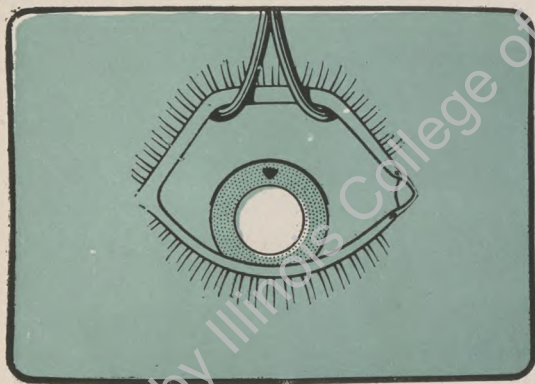


Figure 54.

The excision of the iris ought to be very small and far from the sphincter.



Figure 55.

It is necessary that the lids be held away from the eye. A forcible closure of the lids predisposes to a hernia of the vitreous.

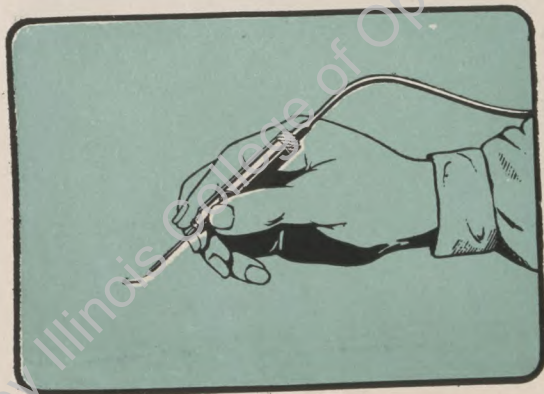


Figure 56.

Position in which the Erisifaco should be held.

valve, we introduce the suction cup into the anterior chamber at the site of the puncture for the right eye, and at the counter-puncture for the left eye, as far as the center of the pupil or even a little lower, behind the iris (Fig. 57), sliding it above the capsule without making the slightest pressure on it, then placing it completely on all its surface. Without the slightest movement of the instrument, we press the button with the thumb and give passage to the vacuum.

By the rarefaction of the air in the tiny suction cup, it adheres to the lens, which ought to fit perfectly, adapted to the surface of its border, deforming it, by shortening its greatest diameter and displacing the nucleus; and as the intensity

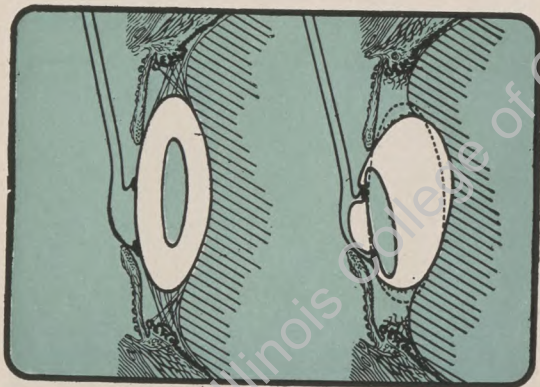


Figure 57.

Left: The suction-cup applied to the crystalline lens—which is in its normal position—is lightly introduced into the posterior chamber.

Right: The dislocation of the lens acted on by the vacuum, the position of the nucleus, and the rupture of the fibres of the zonula are shown.

increases by the intermittence or it may be by the smallest jerks, it imparts to the entire crystalline system a vibration sufficiently intense to rupture the fibres of the zonula (Fig. 58); this vibration is, moreover, sufficiently rapid to rupture the fibres around the lens although the movement does not reach the peripheral insertion of the same.

The intensity to be used in each case varies between 50 and 70 cm. Hg. according to the elasticity of the lens, or the state of maturity of the cataract. These figures hold a certain relation to the age of the subject; the only thing that indicates the degree of vacuum to employ in each case is the practice of making preliminary and careful examination of the physical conditions of the cataract (Fig. 110).

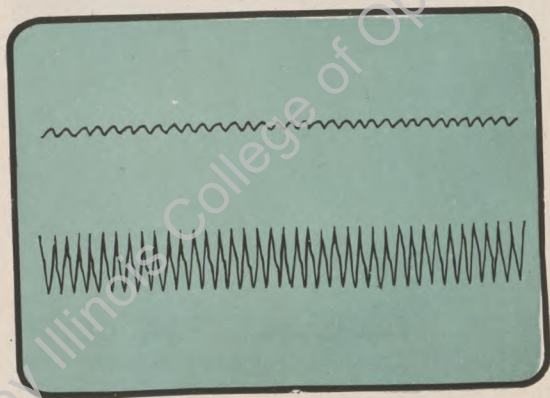


Figure 58.

Tracings of the vibrations of the Erisifaco, by Prof. E. Gallemaerts.

As the intensity corresponds to the height of the wave, with insufficient intensity the fibres of the zonula do not rupture; with an excessive intensity we may break the capsule. In the first case the cataract is loosened from the Eris-faco; in the second case a large cystotomy is made.

Once having caught hold of the crystalline lens by the force of the vacuum, and torn the fibres of the zonula, in order to withdraw the cataract from its position, if an iridectomy has been made it is sufficient to raise its superior border whilst it works upward (Fig. 59, 60), in such a way that the inferior border of the lens follows the curve of the patellar fossa (Fig. 61), in contact with it, without exerting the least pressure or producing friction on its posterior surface. To finish this operation, we direct the cataract at this time toward the scleral lip of the wound, raising the flap by the suction cup which is introduced into the anterior chamber (Figs. 62, 63, 64).

If we try to remove the cataract by the middle part of the flap, the elevator is in the way, or it is necessary to raise the flap a great deal, doing which, the patient could not look down sufficiently; nor ought we open the palpebral fissure excessively; an immeasurable opening of the lids or an excessive depression of the eye predisposes to hernia of the vitreous.

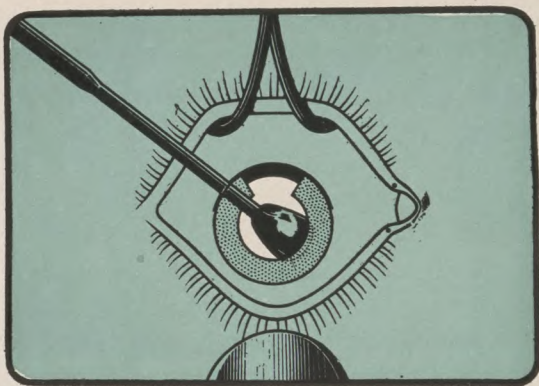


Figure 59.
Position of the suction cup.

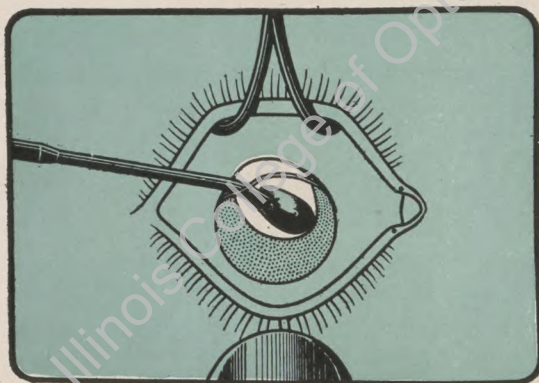


Figure 60.
The inferior border of the lens is advanced by bringing it upward.

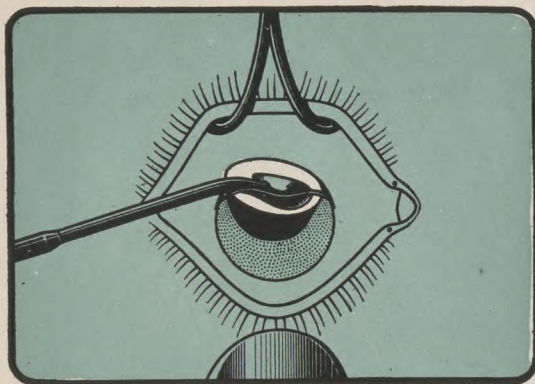


Figure 61.
The inferior border of the lens follows the curve of the patellar fossa.

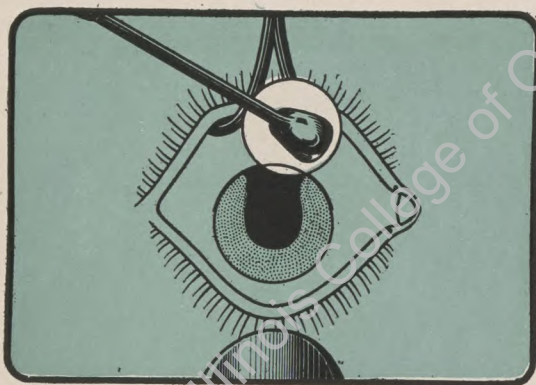


Figure 62.
To finish the extraction the cataract is directed towards the site of the counter puncture in order not to come in contact with the elevator.

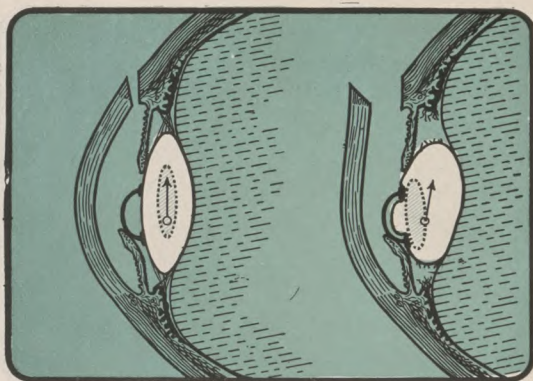


Figure 63.

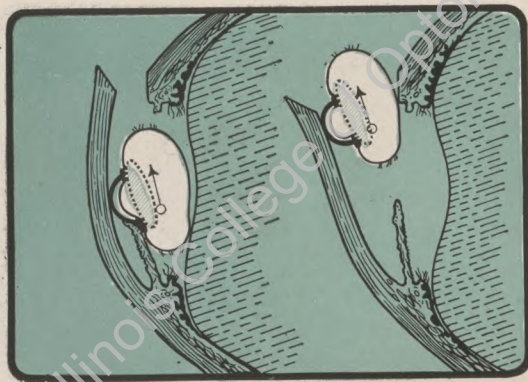


Figure 64.

Figures 63-64. Sections "BB" (Fig. 112) indicate the position of the crystalline lens at different times.

TUMBLERS: (My usual method). Simple extraction with the peripheral buttonhole is made, and the lens is removed by its inferior border, or upside down, which is obtained by making it rise at first directly from above (Fig. 65), less than one millimeter toward the corneal incision and making its inferior border rub on the posterior surface of the iris (Fig. 66), in which movement all the posterior surface of the iris (Figs. 67, 68), remains in contact with the posterior part of the cornea (Fig. 69), and is finished like a combined extraction (Figs. 70, 71), directing it towards the opposite side to the entrance of the suction cup and grazing in this case the scleral lip of the wound with it (Figs. 72, 73, 74). Nevertheless, in Morgagnian cataracts, or in the hard and contracted, the method of extraction may be described as the combined or simple.

During the course of manipulations of extraction which ought to be done with slowness and care, it is necessary that the patient look very low, so that the lids being drawn away from the eye may not make pressure on the globe and any positions that the cataract gets in during this time, could not compress the vitreous.

7. TOILET: In cases of simple extraction, or those with a peripheral buttonhole of the iris, one should employ a $\frac{1}{2}$ per cent ointment of Eserin since the miosis it produces prevents incarceration of the fibres in the lips of the wound and in the combined extraction I use the repositor,

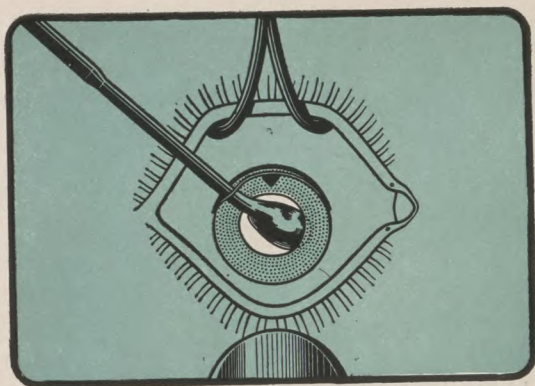


Figure 65.

The crystalline lens is raised less than one millimetre towards the top.

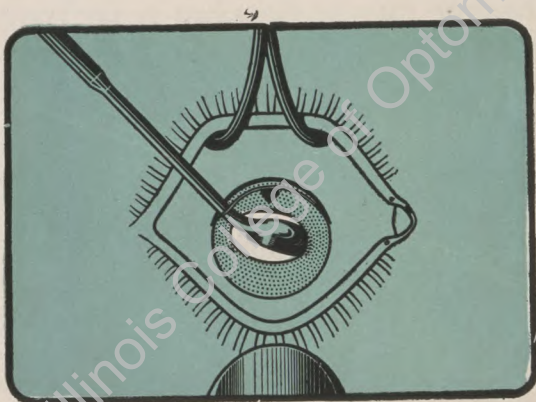


Figure 66.

The movement of rotation commences in such a way that the superior border of the crystalline lens follows the patellar fossa from above downwards.

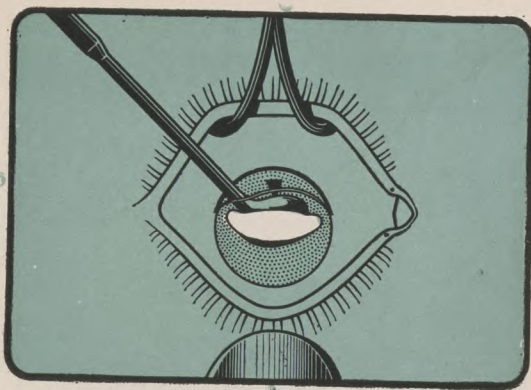


Figure 67.

Represents the period when the crystalline lens has made one fourth of the turn.

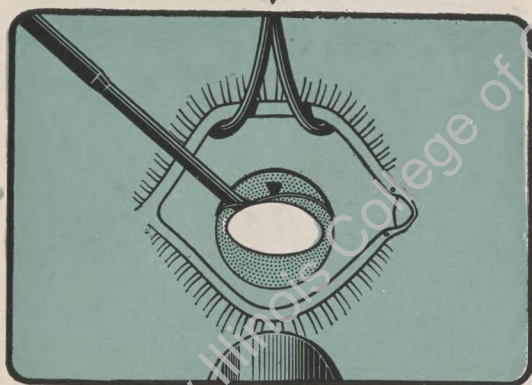


Figure 68.

The posterior surface of the crystalline lens comes in contact with the posterior surface of the cornea.

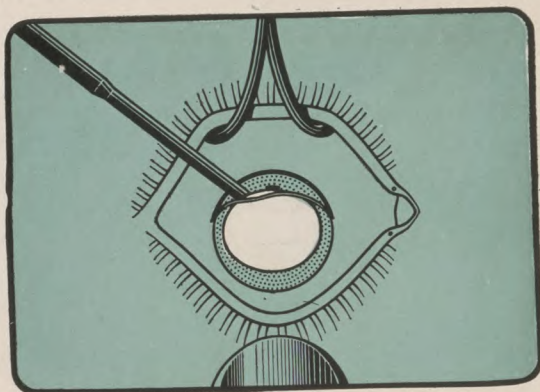


Figure 69.
Represents the last period of rotation.

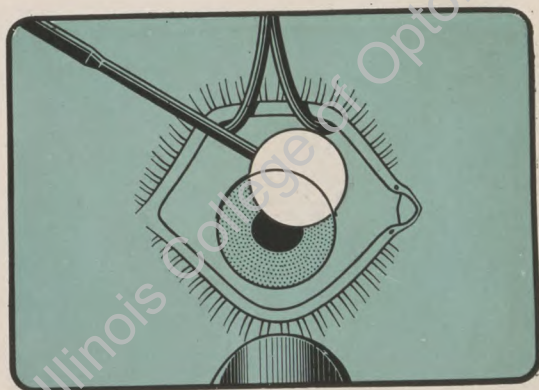


Figure 70.
Withdrawing the instrument from the eye the cataract is removed completely.

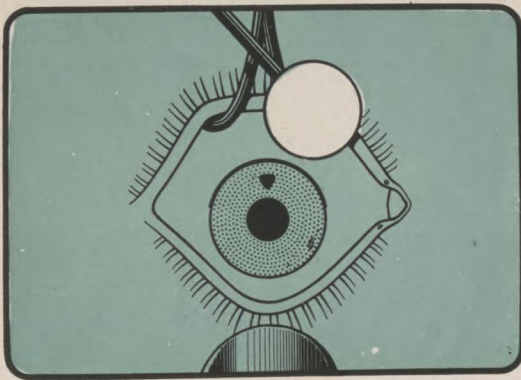


Figure 71.

In terminating the extraction notice that the pupil is black, central, and round, and that we have not left within the eye the least remains of the lesion.

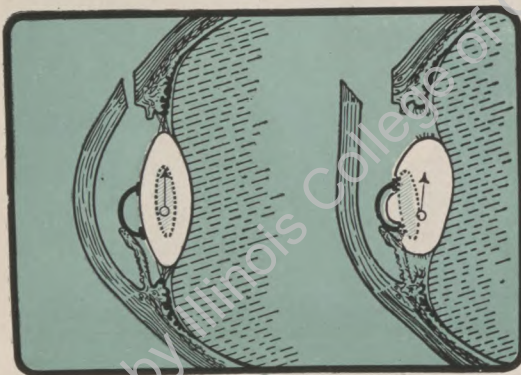


Figure 72.

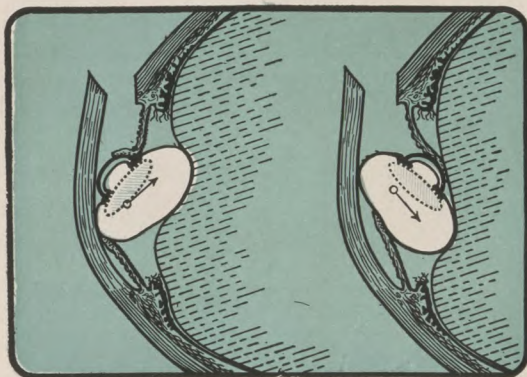


Figure 73.

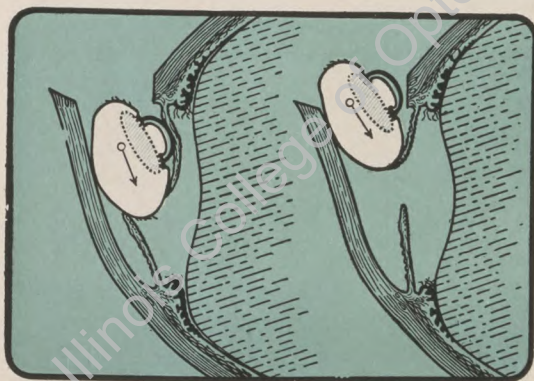


Figure 74.

Figures 72-73-74. Section BB (Fig. 112) represents different periods of rotation of the lens.

gently entering into the wound as far as the angles of the coloboma in order to procure perfect reposition. If the flap has been sclero-conjunctival, we see that this little tongue flap of conjunctiva is well replaced; or we tie the suture if we have used one, and we suture it twice if we consider it convenient (Fig. 75). A folding of the conjunctival flap may retard cicatrization. With forceps we withdraw small coagula that may remain in the conjunctival wound.

8. **BANDAGE:** The patient should close both eyes, carefully, as in sleep and the entire palpebral fissure is covered with vaseline containing bichloride of mercury 1-3000 to destroy the germs that grow along the eye-lashes outside of the skin. A small oval pad made of gauze 4 or 5 centimeters in size, is adjusted to the lids, moistened carefully; a little wad of cotton should fill up the orbital cavity just to the level of the eyebrow without extending beyond it, cover the whole with gauze shaped like an eye flap for horses, that we fasten with a strip of adhesive plaster in the manner shown in the plate (Fig. 76). We see that this bandage does not go beyond the perimeter of the orbits.

Prepared bandages with a layer of cotton of uniform size between the gauze should be rejected. Bandages all around the head produce unequal pressure with each movement on the pillow.

9. **AFTER TREATMENT:** Three or more days following the operation, both eyes are bandaged

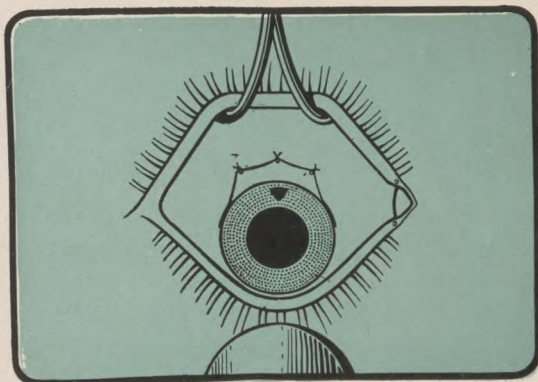


Figure 75.
Final sutures to finish the operation.



Figure 76.
Placing of the bandage with adhesive tape.

after which the operated eye only is kept bandaged for a week. During this period of time, in general, no treatment of any kind ought to be instituted, since if the operation has been performed by observing the necessary rules in every case to the letter, the greater number of patients will not present any reaction or complications; the pupil will be black, central and round, reacting to the light by iridodonesis.

ACCIDENTS DURING OPERATION AND POST-OPERATIVE COMPLICATIONS

1. If the patients are well prepared, there is very rarely any difficulty in performing a peripheral iridectomy. However, by reason of excessive pupillary dilation, the iridectomy may become a total one with the result of an involuntary combined extraction.

2. After incision of the flap, sometimes the pupil contracts rendering difficult the application of the suction-cup which succeeds, nevertheless, with a little skill. In case the iris gets between the lens and the suction-cup, (Fig. 77) it suffices, after having given the lens the turn within the anterior chamber, to interrupt the passage of the vacuum, allowing entrance of the atmospheric pressure into the suction-cup by which the cataract is loosened and to take hold again.

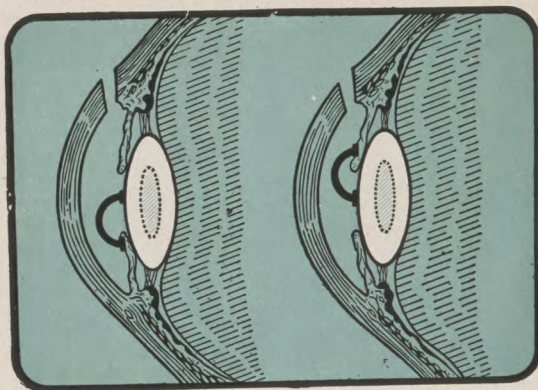


Figure 77.

Left: The suction cup has pinched the iris at its inferior portion by not having entered the pupil due to its slipping on the lens.

Right: The pinching is on the superior part of the pupil and was occasioned by placing the suction cup too far above.

3. RUPTURE OF THE CAPSULE: A. This may occur at the moment the cataract is drawn upon (Fig. 78) indicating that we have made a mistake by employing a vacuum of excessive intensity. B. In some young subjects with a zonula of more resistance one may tear the capsule at its border (Fig. 79) and if the entire capsule and its nucleus are extracted, the remains of the cortical substance are left in the chamber of the eye. C. In completing the extraction, the lips of the wound by squeezing the cataract may rupture the capsule (Fig. 80) and generally in this case the contents of the capsule may be scattered outside of the chamber of the eye in the fornices of the conjunctival sac. Rupture

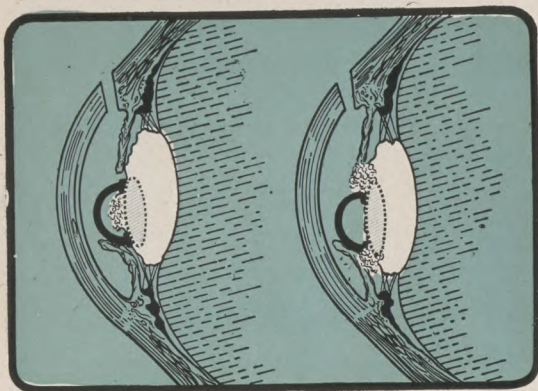


Figure 78.

Rupture of Capsule a.

Left: The capsule is broken within the cup or sucker, and the mass fills up its channel causing a result like that in a capsulotomy.

Right: The capsule is broken outside of the suction cup and it extracts only the nucleus.

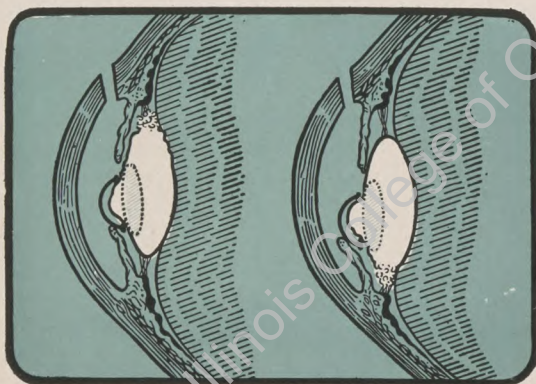


Figure 79.

Rupture of the Capsule b.

The rupture is on a line with the zonula and the erisifaco is able to extract the nucleus with its capsule and a large part of its contents.

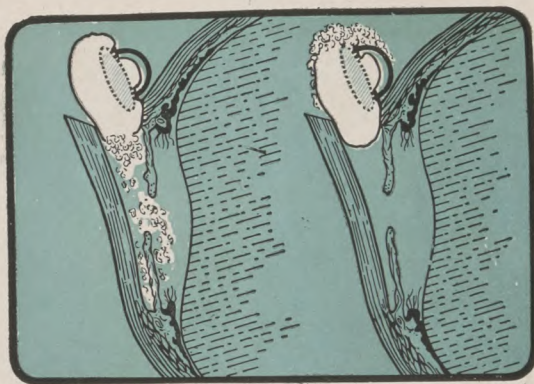


Figure 80.

Rupture of the Capsule c.

When the cataract is squeezed by the lips of the wound—on the right the mass of cataract is scattered in the anterior and posterior chambers, and on the left into the fornix of the conjunctiva.

of the capsule produces no other inconvenience than converting a total extraction into a capsulotomy; this is much less frequent when the surgeon is skilled in the operative procedure.

4. **LOSS OF VITREOUS:** This occurs only when the operator makes undue pressure on the eyeball, or on the cataract by misplacement of the suction-cup (Fig. 81) or if the patient contracts the orbicularis palpebrarum. It occurs very rarely with a paralysis of the orbicularis. Post-operative complications, if the operation has been done without accident and if the patient has not committed any imprudence during the first three days, do not occur save in the most exceptional cases. At times during the three or four days following the operation, a slight traumatic keratitis occurs, which is unimportant. If we have

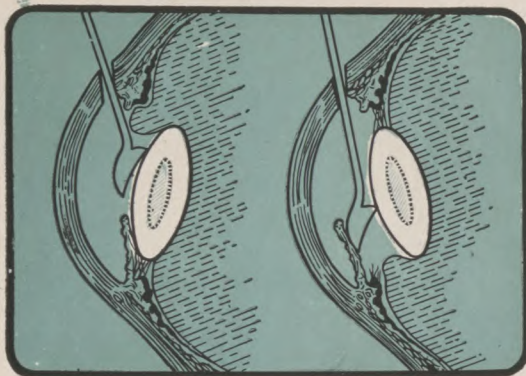


Figure 81.

The suction cup not being perfectly placed on the crystalline lens before using the vacuum, is able to produce a hernia of the vitreous as seen on the left or to aspirate it as seen on the right. One should not produce the vacuum in the suction cup if the cup has not been well placed on the lens nor if the cataract has been displaced.

done a combined extraction, an incarceration of the zonular fibres and the angles of the coloboma in the lips of the wound is possible, producing by retraction in the cicatrix, a plastic iridocyclitis, and secondary glaucoma. In the cases of difficult extraction in which the iris was included in the suction-cup, a slight iritis may supervene. If during the course of the operation the capsule has ruptured, the complications are the same as those that are produced by the capsulotomy. In the cases of hernia of the vitreous, if we succeed in excising it and coapting the lips of the wound with the suture, the pupil remains black, central, round, and like one following slight opacities of the vitreous which slowly disappear. In ob-

streperous patients who are restless, who cough, who are inclined to vomit, or have received any injury, if the operation has been performed with a peripheral iridectomy and suture of the conjunctival flap, the complication is limited mostly to a slight subconjunctival opening of the wound and a drop of hyphaemia, a complication that disappears after twenty-four hours of rest without further consequences. Nevertheless, during some weeks after the operation in these patients, one sees the vitreous herniate through the pupil as shown in plate No. 82.

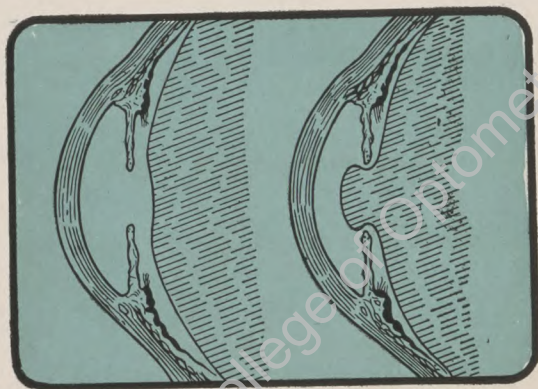


Figure 82.

Eyes operated by Facerisis.

Left: The operative and post-operative conditions have been normal.

Right: A hernia of the vitreous without rupture of the hyaloid membrane in the anterior chamber . . . due to a filling of the chamber two or three days after the operation.

To avoid this complication, I am inclined more every day to use the suture of Suarez de Mendoza which maintains the lips of the incision in

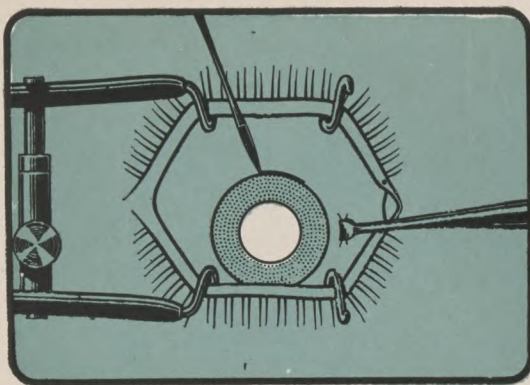


Figure 83.

With a knife we cut in the superior part of the sclero-corneal margin one-half the thickness of the cornea.

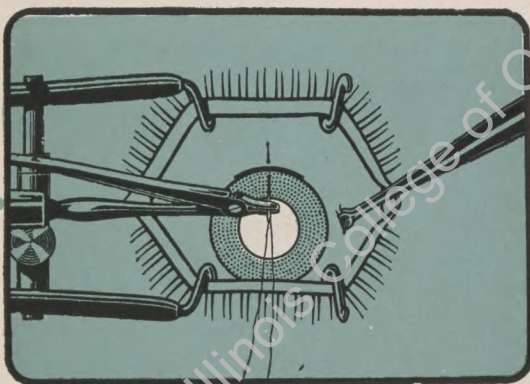


Figure 84.

We pass through the two lips of the incision with a small corneal needle.

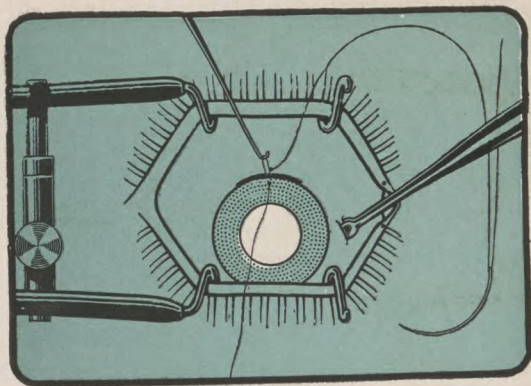


Figure 85.

With a small hook we carry the thread away from the bottom of the incision placing the threads conveniently to be able to enter the wound.

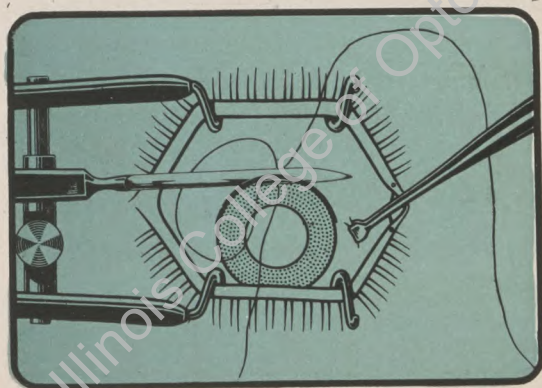


Figure 86.

To finish the flap, the knife ought to come out exactly at the bottom of the incision previously made.

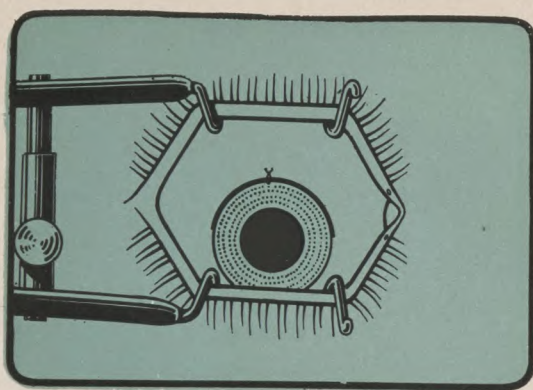


Figure 87.

Finishing the operation and tying the suture, the lips of the wound should be perfectly coapted, without having the silk enter into the chamber of the eye.

intimate union, preventing thus the exit of the aqueous humor, the cause of this trouble, (Figs. 83, 84, 85, 86, 87).

From careful study of the clinical histories of the operated, one concludes that all operative and post-operative accidents are caused by an unforeseen fault of technique, or uruliness on the part of the patient and that most of the successes depend upon simple extraction with peripheral buttonhole of the iris, suture of the flap and temporal paralysis of the orbicularis.

The lack of reactional symptoms due to the simplicity of the surgical manipulations and the absence of the crystalline remains in the chambers of the eye, shorten the duration of convalescence, and assure a normal visual acuity.

PREPARATIONS AND EXPERIMENTS TO EXPLAIN THE MECHANICS OF THE OPERATION

To understand thoroughly the technique of said operation and the mechanics, it is necessary to make beforehand, a number of anatomical preparations and experiments. The lens is held in place solely by the zonula of Zinn; normally, it is attached neither to the vitreous nor to the iris; it is surrounded entirely by the aqueous humor, but much less on the posterior surface which is in contact with the hyaloid membrane in the patellar fossa. The zonula of Zinn is not a membrane; it is a bundle of fibres very close to each other, but isolated, which manifest themselves within the posterior chamber, bathed in the aqueous humor, and are inserted on the crystalline lens in three distinct places, some on the equator of the lens, others a little forward on the anterior surface and the remainder on the posterior surface (Fig. 88) in such a way that we are able to classify them according to their crystalline insertions, into pre-equatorial (a), equatorial (b), and post-equatorial (c). The most anterior, the pre-equatorial are inserted into the ora serrata; the post-equatorial crossing the first are directed toward the ciliary process and the intermediate have their peripheral insertions between the two preceding in the ciliary regions.

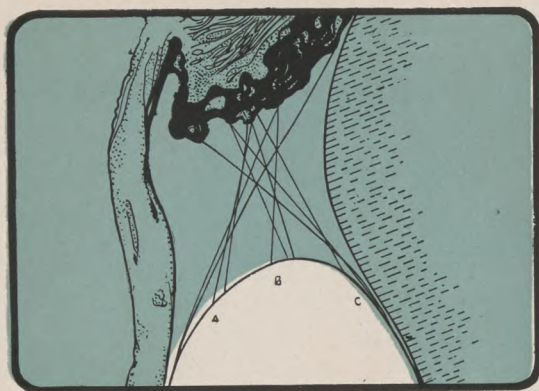


Figure 88.

Sketch showing the position of the zonula.

In their insertions these fibres ramify. The existence of cilio-ciliary and cilio-hyaloid fibres is disputed, yet they do not in any manner affect the lens. The space included between the said fibres and the vitreous is filled with aqueous, and forms a part of the posterior chamber; it is the canal of Petit or Hanover. The fibres of the zonula are veritable connecting elastic tendons, very refringent, stain well with the picric colors whereas they do not with either analine or carmine, like the fibres of hyaloid with which they hold no relation whatever. If we consider the mode of the formation of the eye, we see that the lens appears long before the vitreous and we see that there comes a time when the ciliary processes are intimately united to the equator of the lens by its vascular membrane and in microscopical sections of this embryonic stage, one sees

filaments staining by picric acid that runs from the ciliary epithelium to the lens. The ciliary cells are clearly then the origin of the fibres of the zonula. The fibres of the suspensory ligament measure on the average five microns in diameter; its elasticity and resistance are greater in youth, but diminish after the fortieth year.

With the cataractous process, zonular fragility is increased; in myopic subjects, the zonula is also more fragile than in emmetropes, and hypermetropes. In zonulas of individuals more than 40 years old with a transparent lens, the linear stretching amounts to only one millimeter which these fibres can stand, whereas in young individuals, its elasticity is so great that the stretching may be twice as much. A weight of 30 grammes suffices to break the zonula in an emmetropic eye, more than 40 years old, whilst in the cataractous this weight diminishes in proportion to the maturity of the cataract. In order to be convinced of the extremes that I desire to point out, it is necessary to experiment with some specimens of that region in a way that I will indicate later. Remove the cornea and the iris from the eye of a cadaver, then make a section between the equator and the limbus, like that shown in Figure 89 at "a"; remove the vitreous humor with care and hold it together in a net on a metallic ring (Fig. 94). Having several of these preparations one is able to make the following observations and experiments.

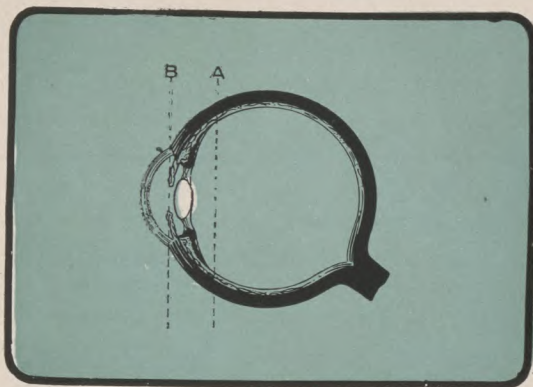


Figure 89.

Indicating the sections to be made in the eye of a cadaver to gain experience which will be explained later.

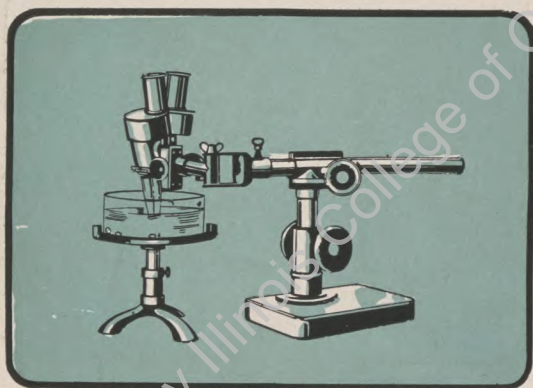


Figure 90.

Binocular immersion microscope.

The first preparation ought to be examined with a binocular microscope under strong focal illumination (Fig. 90) and by displacing the lens in different directions until it is torn loose, we have exposed the peripheral insertion of the fibres of the zonula. Said lens submerged on serum and examined with an immersion objective (Fig. 91), permits us to see a crown of fibres inserted in 3 planes (Fig. 92); those of the anterior surface (the pre-equatorial) rising from it like tangents and their insertion occupying a circular area of one millimeter width. The equatorial fibres are implanted perpendicularly ramifying into two or three thinner fibres, and the post-equatorial are like tangents inserted on the posterior surface of the lens, still occupying an area of about one-half millimeter.

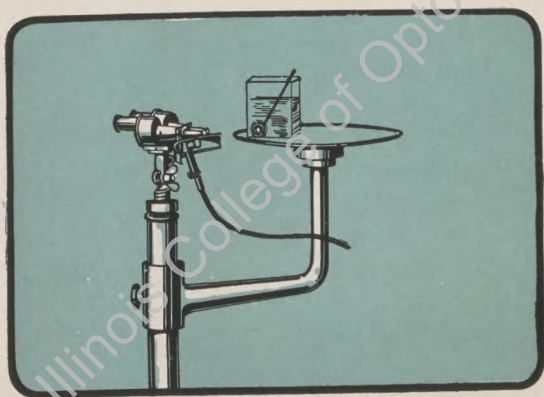


Figure 91.

A suitable arrangement to examine the preparations with the illuminating apparatus.



Figure 92.

Fibres of the zonula under a lens—teased by means of a pincette.

A second preparation should be exposed to a feeble current of air while under observation (Fig. 93), and at the time that the process of desiccation increases, we see the fibres first become tense, then presently some rupture, which affords us a new view to demonstrate the changed automatic disposition of this ligament and the crossing of its fibres.

We use the specimens to study the resistance and elasticity of the zonula under different circumstances according to gentle and sustained traction, or with vibratory suction. The accompanying plates represent the delicate scales employed; in Fig. 94 one sees the pan to carry the weight that is directly sustained above the lens; the greatest linear displacement that the pan allows by increasing the weight to the maxi-



Figure 93.
Anatomical preparation exposed to a feeble current of heated air.

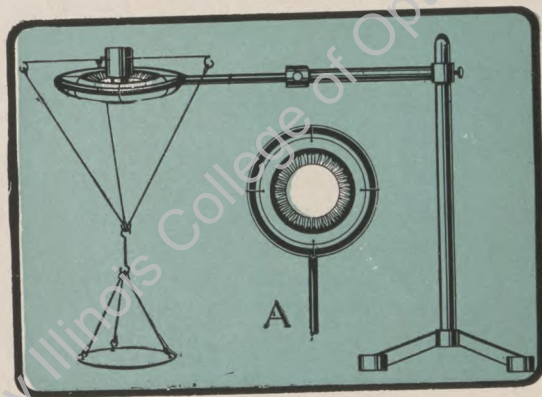


Figure 94.
Apparatus to determine the elasticity and fragility of the zonula.

mum weight that the zonula resists gives us the power of elasticity (Fig. 95) and the minimum weight necessary to break it indicates the limit of its resistance, or the force required to detach the lens; this force is diminished considerably by employing a weight (Fig. 96) since the lens is disarticulated by means of the vibratory vacuum and one gives it the turn as in the technique of the operation (Fig. 97).

A physical experiment (Fig. 98) explains clearly the different ways to make a force continuous or instantaneous; we suspend a thread from the ceiling; at its extremity a weight (a);

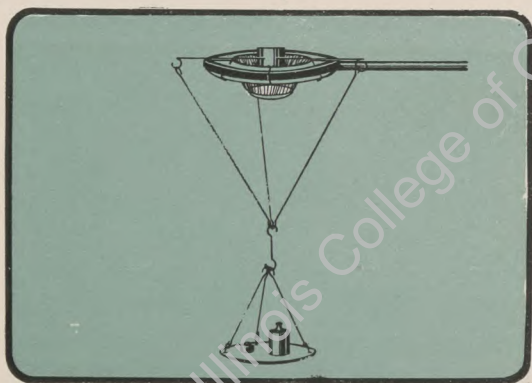


Figure 95.

The fibres of the zonula stretched by a force represented by the weights in the pan.

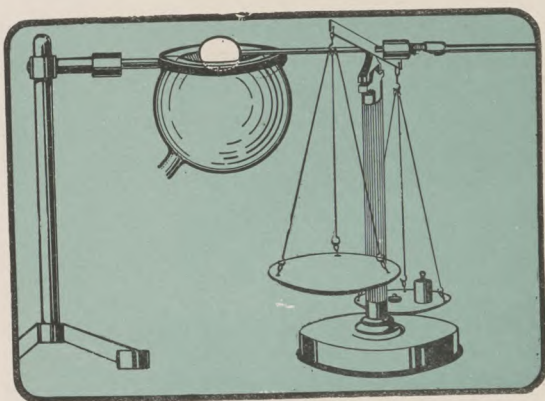


Figure 96.

The weight deposited on the pan causes the suction cup to turn around disarticulating the crystalline lens from the patellar fossa (see Fig. 33).

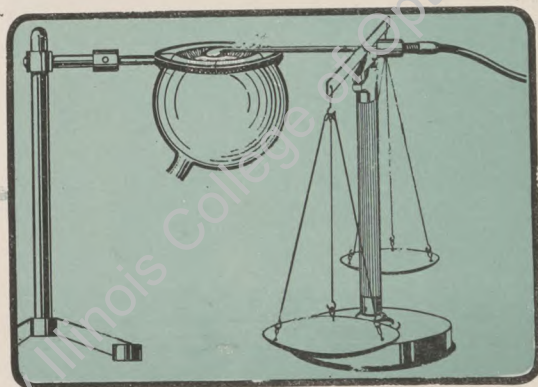


Figure 97.

Apparatus to remove the lens with the Erisifaco.

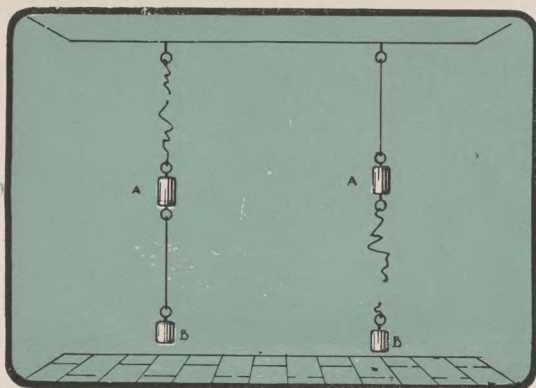


Figure 98.
Experiment by Prof. T. Eseriche.

at the inferior extremity of the weight another thread of the same resistance as the upper one with another weight (b) on its end; if the sum of the two weights represent a force greater than the resistance of the thread, when it yielded by suspending slowly the weight (b), the thread is broken above the weight (a) if the force is represented by the sum of the two weights that act above, all along the length of the thread; if we raise the inferior weight and drop it suddenly, the force has not time to transmit itself as far as the upper weight and the thread breaks at some centimetres from the inferior weight, notwithstanding a lesser weight was used. So

likewise in the lens, with light traction we see the zonular fibres break at the ciliary attachment and in the case in which we employ a vacuum with rapid and frequent interruption, we observe breaking of the zonular fibres joined at the crystalline insertion, before the force has had time to transmit itself to the peripheral insertion without traumatism in the ciliary region for the reason expressed.

The figures 99 and 100 represent two cataracts; the first extracted by an Erisifaco poorly regulated with insufficient altitude of vibration; the second shows a correct extraction. We note with the aid of a binocular immersion (Fig. 91) the different lengths of its fibres, and compare both with those of a lens removed by the aid of forceps (Fig. 92).

It is likewise useful to consider the resistance of the hyaloid membrane and the reasons that occasion its rupture during operation.

Remove the cornea, iris, and the lens from one eye (Fig. 101); we see the patellar fossa preserving its concave shape. If we exert a light pressure on the sclerotic with the fingers, which produces a convexity, it becomes enlarged without rupture of the hyaloid membrane or escape of the vitreous; by increasing the pressure we see clearly, at the movement of rupture of the membrane, the escape of the vitreous. In other preparations, we observe the escape of the vitreous humor by just touching the patellar fossa with a pointed instrument.



Figure 99.

Cataract with large fibres of the zonula, extracted with small vibrations.



Figure 100.

Cataract properly extracted.

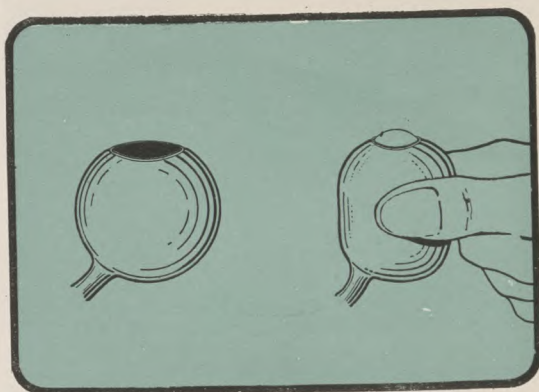


Figure 101.

The eye of a cadaver in which the section "B" (Fig. 89) has been made and removal of the lens. At the left one sees the vitreous in form of a concave surface, the patellar fossa. At the right by compressing it between the fingers, the vitreous undergoes a hernia without rupture of the hyaloid membrane—if the pressure is not excessive.

By means of a delicate dissection of an eye immersed in serum, we are able to obtain, after having deprived it of its fibrous tunic, and the uvea with the lens and retina, the entire vitreous body, without rupturing the hyaloid membrane, which may be taken with the fingers, passed from hand to hand, drawn from its container, without losing its spheroidal form nor escaping (Fig. 102); then the least pressure suffices, as the contact of some instrument stops the hernia—the vitreous escaping completely (Fig. 103).

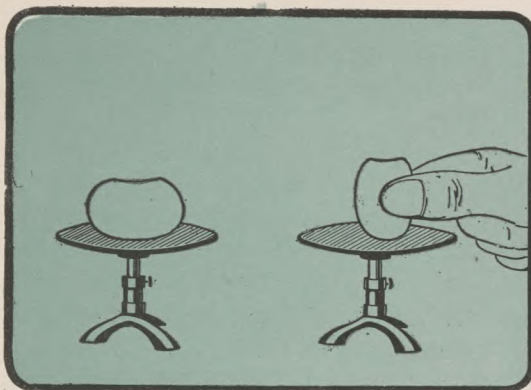


Figure 102.

After a delicate dissection one is able to extract the human vitreous between the fingers, without tearing the hyaloid membrane or without causing other deformity as is seen on the right.

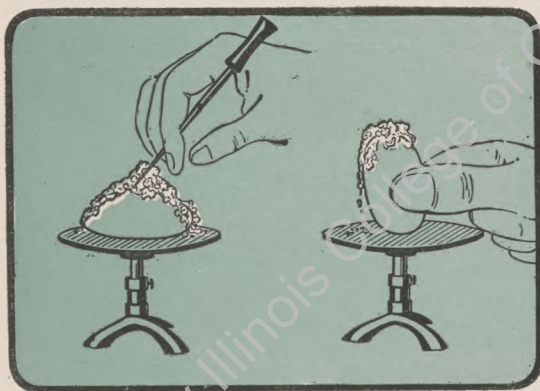


Figure 103.

An excessive pressure on the right and a puncture on the left produces a rupture of the hyaloid membrane, entirely scattering the vitreous.

The existence of this hyaloid membrane was once disputed, especially at the site of the patellar fossa; without doubt modern investigations incline one to believe that the kind of vitreous that constitutes the hyaloid membrane at the site of said fossa is much more delicate but still exists, as the preceding experiments and careful observation show by the use of the binocular of Zeiss and the Slit lamp of Gullstrand, the distinct covering of the vitreous in the operation of total extraction.

After repeatedly having made the aforesaid preparations and experiments, we may practice the operation according to the technique of Fisher, on cats six weeks old, by which skill may be acquired in making the incision (Chapter IX).

In order to show the importance of the position of the lids and direction of fixation of the eye of the operated person, it suffices after making the flap to open the lids without raising them from the eye, and to tell the patient to look as low as possible and notice that the flap opens, proof that the eye undergoes pressure.

EVOLUTION OF FACOERISIS

The idea of getting hold of the crystalline lens by means of a vacuum and extracting it, was suggested to me by the observation of a leech, which adhering to the wall of an aquarium by its buccal sucker, raised a small pebble with its caudal end. With a canula shaped like the cupula of the aspirator of Reda, I made my first

trials and convinced myself that the force of suction was inadequate and that the area of suction was too small. I observed that the force of suction depends evidently upon the area and intensity of the vacuum. A metallic box provided with a vacuo-meter, in which previously I had produced the vacuum, served me for experimentation, showing that there ought always be a vacuum above 45 cm. of mercury and never more than 70, with a suction-cup of a size compatible with the dimension of the eye, and that the intensity of said vacuum ought to be different according to the physical conditions of the cataract to be operated and the resistance that the zonula offers to rupture.

For greater convenience, I replaced the vacuum box by a water flask (Fig. 104) with

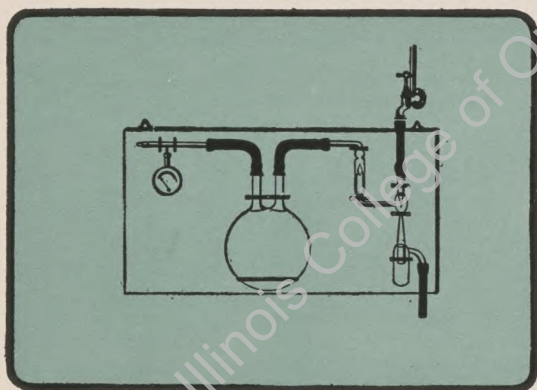


Figure 104.

With a water flask the greater or lesser intensity of the vacuum is obtained by opening or closing the stop-cock. Notice the vacuum indicator at the left.

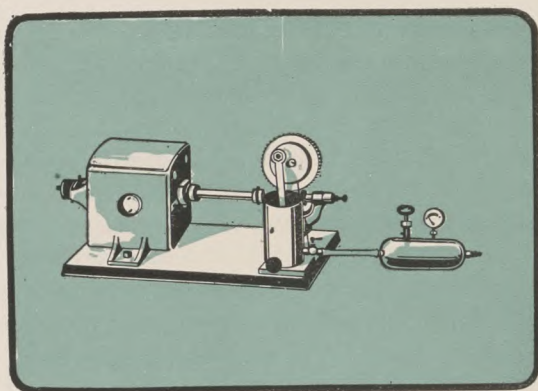


Figure 105.

An electric motor runs a monocylindrical pump by means of a driving gear, making a vacuum in a little reservoir that carries a regulator and a vacuometer.

a constant vacuum, and (afterwards by an apparatus of aspiration or suction) run by an electric motor (Fig. 105). I always operated with an iridectomy and ruptured the fibres of the zonula to extract the lens, which then appears with a crown of zonula fibres like the representation in Figure 92. By examining those patients with the corneal microscope it was noticed that in some, remains of zonular fibres are incarcerated in the lips of the wound and incarcerations of the angles of the coloboma, that cause iridocyclitis by which the post-operative course of my operations was disturbed.

I decided to spare the sphincter of the iris at any cost to avoid these incarcerations and did the operation in mild atropinization; yet at that

time there was a hernia of the iris which almost always interfered with a brilliant result; the employment of a mydriatic of fugacious action and of eserine to finish the operation, diminished the accidents which I have seen disappear altogether by invariably making the peripheral buttonhole of Hess. Even in some cases considered as inconvenient for removal of the lens without giving it the turn, or tumble, either the extraction is made difficult, or the sphincter is torn, converting the operation into a combined extraction. More than one year I operated in this manner without being able to avoid incarceration, iridocyclitis, or loss of vitreous.

Operating in the Lariboisiere Hospital, Paris, Dr. Dilliard of Montpellier advised the use of novocain injected in the course of the facial nerve to paralyze the orbicularis palpebrarum. Following his advice except in rare cases, I have not had any hernia of the vitreous, with which there might have occurred in some instances the benign post-operative iridocyclitis which undoubtedly is due to the traction on the ciliary body.

I made due progress by extracting the lenses without making the turn or tumble like that shown in Figures 72, 73 and 74, always keeping intact the peripheral buttonhole of the iris; nevertheless my lenses dragged a great length of the zonula until having substituted the pneumatic machine for the other that produces an intermittent vacuum due to its various cylinders (Fig. 106) I noticed with great satisfaction that

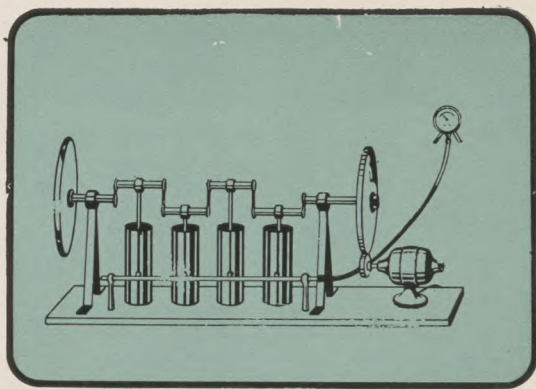


Figure 106.

In this apparatus the motor runs four pumps and has no reservoir so that it may have interruptions in the production of the vacuum.

in the majority of cases the fibres of the zonula were torn more around the lens. At that time I constructed my first pneumatic machine, in a way that the number of interruptions per minute might vary in order to be able to determine the proper way to break the fibres of the zonula joined to the lens, which I did with five thousand interruptions per minute.

In this manner avoiding the traction on the ciliary region, and hernia of the iris being impossible because of the iridectomy of Hess, I had therefore protection against the principal accidents. Still the suture of the conjunctival flap which every day, I realized more and more, was not sufficient in some patients to prevent the wound from gaping during the days that followed operation, and the above mentioned con-

junctival aperture delayed the post-operative course and some patients presented a slight hernia of the vitreous in the anterior chamber. (See Fig. 82.)

In spite of all the difficulties described above, the general results of my operations were more satisfactory than by operating with the cystotome, since the remains of the capsular contents left behind within the eye in the extraction with opening of the capsule, are of greater importance in post-operative complications and the principal origin of inflammations.

Recently I have substituted the conjunctival for the corneal suture of Suarez de Mendoza (Figs. 52, 75) which maintains an intimate union of the lips of the incision.

PRELIMINARY EXAMINATION OF THE PATIENT, AND REGULA- TION OF THE ERISIFACO

We have in previous paragraphs spoken of the necessity to perfectly regulate the intensity of our vacuum by adapting it to the physical condition of the cataract to be operated, and the age of the patient. We have seen that the lens to be drawn by the suction-cup is deformed, by diminishing its greatest meridian in diameter and breaking the fibres of the zonula attached to it, (Fig. 57) because of the very rapid tractions that the interruptions of the vacuum exert upon them. A very hard cataract causes more de-

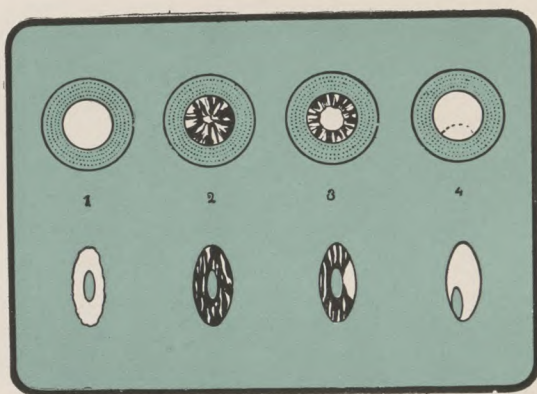


Figure 107.

1. Hard senile cataract.
2. Senile white cataract (ripe).
3. Posterior polar cataract.
4. Morgagnian cataract.

formity than a white one, (Fig. 107-1-2) on account of the great necessity of a very intense vacuum; whereas a white cataract is deformed with more facility, and like that in the stage of intumescence the capsule is distended and drawn; a less intense vacuum causes an exaggerated deformity and may produce its rupture.

When the cataractous process is less advanced, as a rule, the zonula is less friable, which requires the employment of a greater number of interruptions of the vacuum. In an Erisifaco that low voltage will operate because it has been constructed and arranged in accordance with the density and viscosity adequate for it, the number of interruptions increases as the intensity of the vacuum is diminished by the regulator, in such

a way that the surgeon ought to try to regulate the intensity of the vacuum in proportion to the hardness of the cataract, which may be determined with great accuracy by the examination of the patient with a dilated pupil, measuring the depth of the anterior chamber and the distance between the two capsules, determining if there are any transparent portions in the lens, by means of focal illumination of Gullstrand and the corneal microscope of Zeiss with the graduated drum (Fig. 108, 109). With practice in my operative procedure, all kinds of senile cataracts may be operated by facoerisis, excepting the dislocated. The posterior polar cataracts, symptomatic of malignant myopia (Fig. 110-3) when they present any peripheral striae, may be extracted with the best results.

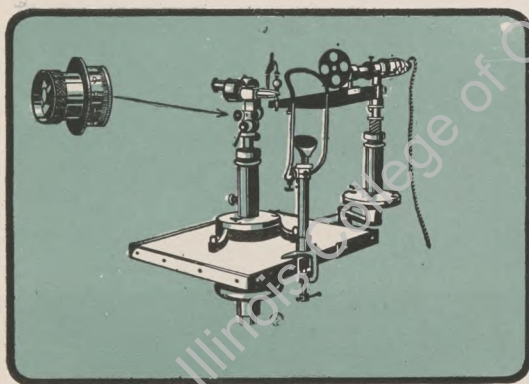


Figure 108.

Microscope of Zeiss and lamp of Gullstrand with a drum graduated to measure the thickness.

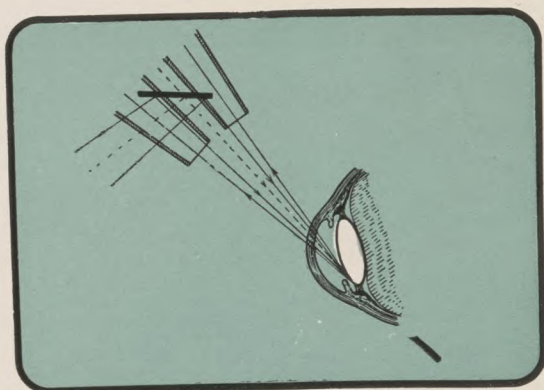


Figure 109.

Manner in which the bundle of rays is directed with the mirror of Koepe, in order to examine the peripheral insertion of the zonula.



Figure 110.

1. Semisolid cataract (ripe).
2. Almost white cataract, containing much water.
3. Hard senile cataract.

ADVICE TO THE BEGINNER IN FACOERISIS

1. Do not think that the Erisifaco is an instrument which automatically removes the cataract.

2. To practice this operation one should have the surgical instinct and I do not believe it prudent to operate without having previously made the experiments before mentioned.

3. In the first operations, do not choose symptomatic or complicated cataracts; select an old patient with a senile cataract—mature and in excellent condition.

4. Take special care during the entire operation to make the least possible pressure on the eye-ball and crystalline lens.

5. Do not in your first operation try to change in the least possible way the details of the technique described; and be most exact in following them out.

6. If the flap, the iridectomy, the application of the suction-cup, or the preparation of the patient has not been correct, or if at any stage of the operation difficulties arise, do not persist in the use of my technique in your first cases, but terminate the operation by the usual method.

7. Before every operative session, regulate the Erisifaco—assuring yourself that its tubes are completely open and that the valves work perfectly. Nor is it superfluous to examine the

Graefe knife or the scissors since their defects are the cause of faulty section of the flap and injury of the iris by which the operation becomes more difficult and its results compromised.

8. First make a detailed examination of the patients and examine them carefully on the different days following the operation by means of a corneal microscope with high power in order to acquaint yourself with the defects of the flap—with the imperfection of the iridectomy, and the state of the vitreous (Fig. 111) etc., etc., and only in this manner with a methodical study of all cases and complications will you be able to attain the desired perfection.

CONCLUSIONS

The first attempts at extraction were the total, which seemed to be the most rational. All the modifications of capsulotomy endeavor to leave within the eye the least possible quantity of the lens, because these remains are the cause of post-operative complications.

In the extraction of cataract, we should endeavor to remove all the lesion, without producing intra-ocular ectopias, and with the least possible traumatism.

The erisifaco is a pneumatic forceps and zonulotome and ought to be kept perfectly regulated in accordance with the physical condition of the eye to be operated.

It is necessary to familiarize oneself beforehand with the mechanics of the operation so

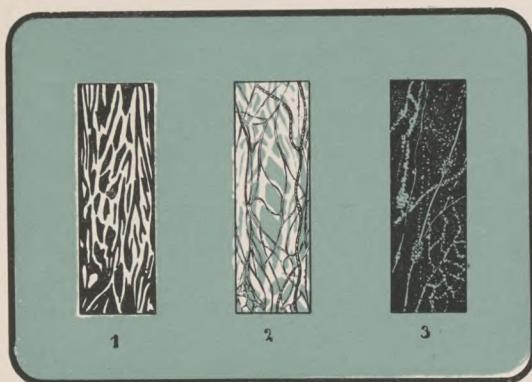


Figure 111.

1. Normal vitreous.
2. Vitreous after rupture of the hyaloid membrane.
3. The vitreous after a rupture of the hyaloid membrane and iridocyclitis.

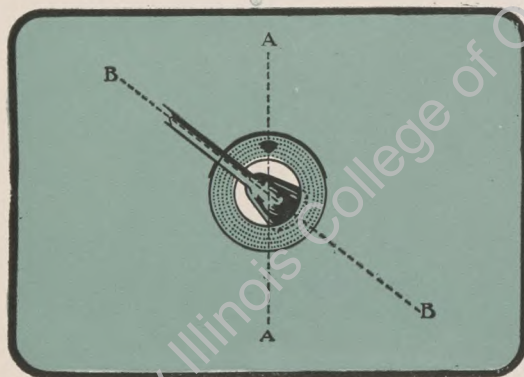


Figure 112.

Sketch to show the direction of the sections.

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that no difficulty or accident may arise, if the method outlined is employed.

The majority of operative accidents and post-operative complications depend on a faulty technique or want of foresight and are usually avoidable.

A systematic and minute study of the eye—before and after the operation is necessary.

CHAPTER III

Capsulotomy Operation

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DAVIEL'S OPERATION: This operation dates from 1745 when Daviel opened the aqueous chamber, scratched the capsule, and squeezed out the lens matter for the first time. The couched lens had before that time been extracted when it made its way in front of the iris, a position in which it set up much mischief; but as the couched lens very seldom makes its way in front of the iris, there was but little experience of this procedure. The lens never makes its way in front of the iris until it has become so much absorbed that it is a very small body.

The various modifications of this operation since the days of Daviel when closely examined are not of importance. How trifling they are is indicated by the fact that not one of them has been universally adopted.

CLASSICAL OPERATION: We see the term "Classical Operation" applied to Daviel's operation. This is correct as regards age since 1745; but as a matter of fact, the mortality of eyes from sepsis until Listerism was adopted was so prohibitive that the operation was very little practised in any country until Listerism was established, which we might from our point of view put down as about 1880.

Previous to that date, couching was the operation almost exclusively done. The late Sir Johnathan Hutchinson told me that they would not have given up couching in London, but for the fact that the retina atrophied following couching in all cases. He was the only man I have met who knew this fact.

Daviel's operation is admissible in all ripe cataracts if the eye is otherwise sound. If otherwise sound and there are adhesions of the iris to the lens, these should be separated before the capsule is lacerated, otherwise a severe iritis is likely to follow. This is easy to do as the adhesions are generally of a very weak nature.

PREPARATION OF THE PATIENT: The patient should have a cathartic the day before operation, because if this is not done, when such patients are laid up in bed, they do not digest their food, nor sleep as well as usual. They should also have a laxative a day or two days after the operation in order that there should not be straining at stool, as well as to make sure that the bowels are quite easy. This should be repeated through-

out the period of convalescence, because there is nothing which acts so unfavorably on these cases as constipation, even of the mildest degree.

A constipated patient often complains of pain in the operated eye, and on inspection the eye looks congested. This condition at once disappears after a mild purge. A few leeches to the temple also assists in relieving it.

ATROPIN BEFORE OPERATION: The patient should have a few instillations of a 1 per cent atropin sulphate the day before operation and a few more on the day of operation, so as to be well under its influence. In this case atropin will not be indicated for ten days and the patient will not require meddlesome dressing and instillation of drugs.

DIABETES OR BRIGHT'S DISEASE: Diabetes, or Bright's Disease, is not a bar to operation, although diabetics are much more subject to iritis than ordinary cases. These cases imperatively require that the patient should be kept absolutely free from constipation and that the sugar content of the urine be kept as low as possible, both before and after the operation. If iritis occurs, the patient should be freely purged for a few days to get rid of the abnormal material circulating in the blood. It should be impressed upon the surgeon, whether it is an ophthalmic or a general surgical case in diabetes or albuminuria which is going wrong, that no way is so rapid and efficient in putting the patient right as very free purgation continued for

one, two, or three days. It is astonishing how post-operative hiccough—the usual indication that the patient should hasten to make his will—disappears when ten to twenty motions occur in the first twenty-four hours and continue for another day or two if necessary. The patient thrives on this treatment. This general surgical issue is intended to impress on the reader, the importance of attending to the condition of the bowels in these cases.

The patient should be given a grain of blue mass three times daily, commencing the day before operation and continued for seven or eight days, so as to have him under the influence of mercury in case iritis develops.

There is no doubt that mercury exercises a powerful influence in controlling iritis and in causing absorption of lens matter. If the above instructions are carried out, daily inspection of the eye is not necessary. If iritis develops one can do no more for it than is being done. In this manner one "takes Time by the forelock," which is very important.

There is no region of surgery in which daily dressing, which most general surgeons would call meddlesome, is fraught with more evil consequences than in cataract cases. If the surgeon's plan of campaign has been sound, meddlesome dressing is not necessary.

NERVOUS PATIENTS: If the senile cataract patient is at all nervous, if a male he should have 120 grains of bromide of potassium; and in the

case of a female 100 grains eight or ten hours before operation, in a single dose.

Patients do not get the full effect of the bromide in less than eight hours. It will quiet nervousness, insure sleep that night and without a further dose, its influence will insure sleep on the following two nights. Various drugs have been tried for this purpose, but bromide administered in this manner is the safest and most efficient.

The above dose of bromide will not be considered very large, when we consider that an alienist thinks nothing of giving epileptics 180 grains daily for a month. I experimented with bromides after having dissatisfaction with other agents, and I increased the dose until the above dosage was reached. Sixty grains makes the patient more nervous. It is not until ninety or more grains are given that one begins to see the desired effect developing.

MORPHIA: Morphia is objectionable as these patients have a great tendency to vomit.

PREPARATION OF THE FACE: The neighborhood of eye should be well washed with soap and water and then with some antiseptic solution. A sterile towel should be put around the head so as to keep the hair from contaminating anything which may enter the conjunctival sac.

LACHRYMAL SAC: The lachrymal sac should be examined and if it is diseased, the operation should be deferred until corrected.

CONJUNCTIVA: If the conjunctival sac appears normal, it is quite safe to operate.

EYE LASHES: The eye lashes should be cut off at the outer end of the upper lid and the margins of the lid well cleansed with cotton wool or gauze saturated with some antiseptic.

THE SPECULUM: A screw stop on a speculum for this purpose is an abomination. Occasionally it is necessary to snap it out on very short notice and if it is fixed, one cannot do this. A spring speculum with some form of stop which prevents it from opening too wide is the best as it can be rapidly taken out on short notice.

If the patient is not troublesome, a speculum is preferable to a retractor. If nervous the retractor is best, because the patient has no control over it.

The speculum, or retractor, is inserted, the lids lifted forward, the brow drawn upwards, and a douche, with preferably five or six feet pressure, i. e., five or six feet above the table, containing some sterile salt solution or antiseptic solution, (1-2000 perchloride of mercury) is turned on and freely used to wash out the conjunctival sac. The pressure of such a douche has considerable scouring force, which is sufficient to mechanically clear the sac.

The non-importance of the quality of such solution, should be emphasized, because it is not the agent but the *mechanical* cleansing which is important. This is a noted fact in general surgery, which is not yet sufficiently recognized,

even after the experience of the great war, though war observation was rapidly moving in this direction.

THE INCISION: The incision should begin in the sclero-cornea and finish where the operator fancies. One never regrets having an incision larger than necessary, but always regrets having it too small. 180 degrees is the proper size to extract a lens in its capsule and is a safe size as far as the vitality of the cornea is concerned.

THE KNIFE: The knife should be held with the edge turned slightly forward, or apparently turned a little forward. Every beginner thinks his knife is on the flat when in reality it is turned back, hence it does not cut well because he is not pressing it fairly but only partially against the edge.

When the point reaches the nasal side, the operator should twist the knife forward to an angle of thirty degrees and push it through. If he pushes it through on the flat, it tends to come out too far back, whereas, using it as above described, it comes out exactly where he wants it, and does not split the sclerotic. In using the knife, the operator should hold it like a pen, and much further from the steel than usually advised. He should hold it as lightly as a pen is usually held; when the point is through, it is grasped more firmly.

If the operator has a firm or heavy hold when going through, the knife will cut as well as puncture, the result of which will be that the

aqueous will escape too early and the iris may come forward over the knife. In such a case there is no option but to go on and the knife will do the iridectomy.

When the point is through at the nasal side, the knife should be pushed on to the heel, lowering the handle so as to clear the nose if necessary, making the knife cut as it goes through on the nasal side only, which generally should complete the incision.

If this does not complete the incision, a single light draw back, this time using the heel of the knife to cut out in the temporal side, will finish. Why not use it to cut both the temporal and nasal side at the same time? The practical fact is that the knife cuts better and with much lighter pressure as above advised (Figs. 113, 113a, 114, 115).

CONJUNCTIVAL FLAP: If a conjunctival flap is desired, it should be continued sclero-corneal throughout.

If an iridectomy is not intended, the incision should end in the cornea so far forward as not to come in the way of the pupillary area. The further forward the incision ends in the cornea, the less liability there is to prolapse of iris. The wound should be 180 degrees of the circumference of the cornea; two-fifths of the circumference, as usually recommended, is large enough, in case nothing unforeseen happens, but unforeseen things occasionally do happen.

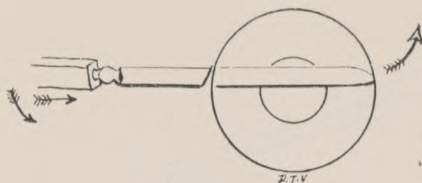


Figure 113.

Showing the knife as the point disappears under the limbus in making the counter-puncture. As soon as the point emerges the handle is lowered. The knife driven slowly forward and the blade made to pass over the bridge of the nose until it is in to the hilt, after which the handle is elevated.

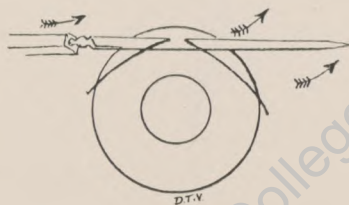


Figure 113a.

Showing how in some cases the incision can be made by a single forward thrust of the knife (no draw-cut and no sawing-cut). The arrows show the direction to make pressure in completing this cut. The edge of the knife is turned forward toward the cornea.



Figure 114.

Showing the first position of the hand and proper hold on the knife, a little back of the center of the handle and very lightly.



Figure 115.

Showing the third position of the hand in making the section. The fingers are straightened out. The knife held lightly. The position is favorable for lowering the handle and continuing the forward cut until the blade is through to the hilt, when by raising the handle the section is completed.

DISLOCATED LENS: Even in the best hands a lens is not infrequently dislocated in the effort to open the capsule, and in such a case the operator should be able to extract in capsule, which he cannot do with an incision less than 180 degrees. In this case he cannot go on endeavoring to rupture the capsule and even if he succeeded, he would mix lens matter with the vitreous and probably fail to get out the nucleus; greater complications would result, followed probably by a violent iritis, the outcome of which might be disastrous.

THE CAUSE OF THE IRIS FALLING ACROSS THE KNIFE: This is the common accident of the beginner. The beginner's hand is heavy and when driving the knife across, he both punctures and cuts the temporal side, which allows escape of the aqueous. He also, usually presses the eyeball with the end of the catch forceps at the same time, and this also causes the iris to come forward. Both causes should be avoided. Practice alone will eliminate this accident (Chapter IX).

The incision finished, if a speculum is being used, the operator in case he is doing an iridectomy should see to it that his assistant, while fixing the eye, holds the speculum ready to lift it forward in case the patient is going to struggle on account of pain caused by catching the iris, or from nervousness, otherwise the patient can easily squeeze out the lens and some vitreous. If the assistant is using a retractor, the patient is practically under his control (Fig. 116).

IRIDECTOMY: (Fig. 116) The operator drops the proximal leg of the forceps into the upper edge of the incision and against its scleral margin allowing the forceps to be wide open, and strokes the cornea with gentle pressure with the other leg while closing the forceps; the iris is flooded into the grip of the forceps.

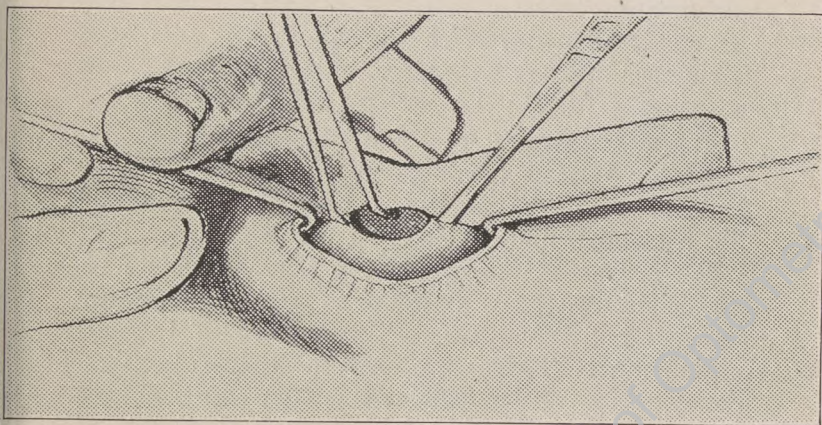


Figure 116.

Iridectomy Intracapsular Method: The upper blade is placed just above the corneal incision and the lower just below the upper edge of the pupil, when a little pressure is applied upon the lower blade which is brought upward, pushing the iris out when the two blades come together; the iris is caught, gently pulled out, and cut with scissors.

This is the right way; it is both elegant and simple and a special light is not required. If the operator prefers to insert a forceps, a good light is necessary. In any case he should catch the iris very lightly, so as not to hurt the patient. The iris is very sensitive to bruising and pulling with the forceps, and the operator should avoid

both by drawing out the iris only just as far as required and snip it off. The actual cut of the scissors does not seem to hurt the patient, but the least rough handling does hurt.

ASSISTANT: An assistant should always fix the eye while the operator is doing the iridectomy, because with the slightest pain a nervous patient may give a violent shake of the head and leave the operator with the whole iris torn out. This accident has happened, and happened much more often than it has been published.

CAPSULOTOMY: The iridectomy finished, the operator should hold his speculum in his own hand when operating upon the left eye and let his assistant hold it in case of the right eye, while he passes in one of the many forceps—a good iris forceps is as good as any—and grasps the front of the capsule with a wide grip, tearing a piece out. This is the best method of opening the capsule. In patients over fifty years of age, the operator with this grip, occasionally brings the lens in capsule with him. If the patient is over seventy, and the operator is at all heavy in the hand, he can easily dislocate the lens and open the capsule at the same time.

DELIVERY OF THE LENS: The operator should depress the scleral lip of the wound with a spoon or spatula, and at the same time with some such instrument as a strabismus hook, (using the convexity of the curve) press the lens through the cornea, stroking it toward the wound, making as much as possible come out at the first effort. He

should then with the same instrument, massage through the cornea towards the center of the pupil, so as to shift as much as possible of the loose lens matter in that direction, and then direct it through the wound.

The common mistake of leaving much lens matter in the eye, is due to the fear of injuring the cornea. There is no foundation in fact for this fear, as the cornea will stand as much such massage as any other epithelial surface, without showing reaction. When the operator has finished with the delivery, he should search the margins of the wound for any tags of capsule which may be lying about. An ordinary dissecting forceps is the best instrument for this purpose. The operator should then carefully replace the iris and if he has made a conjunctival flap, he should adjust it.

Before taking out the speculum, or retractor, the patient should be asked to close his eyes. When the patient is seen to roll his eyes as in sleep, the speculum, or retractor, should be removed. It is very awkward when you take out the speculum or retractor to find that the patient is violently opening and closing his eye while the operator is struggling with him to make him understand what he wants him to do. These patients if nervous, are often in dreamland and not listening to the operator; hence the struggle.

IRRIGATING ANTERIOR CHAMBER: Some use McKeown's douche to supplant the corneal massage above mentioned. The writer prefers the

massage. The best way of using the douche is to have the irrigator fixed in a stand, or above the table to which a rubber tube and nozzle, preferably metallic, is attached. The nozzle should be inserted and shifted around the capsule and the stream should have a fair amount of force or pressure which can be regulated by the height of the container. The fluid of course, should be warm normal saline. Like all other things of the kind, it requires a light hand and a fairly good patient. If either of these are unfavorable, the nozzle is likely to penetrate the capsule.

DRESSING: The lashes and margin of the lids should be smeared with sterile vaseline or some mild sterile ointment to prevent the dressing adhering to the lashes.

A pad of cotton wool should be placed over each eye and the eyebrow and forehead, and fixed in position with strips of plaster and a bandage, or one of the various masks, and the patient put to bed.

CATARACT UP TO THE AGE OF 30 YEARS: These cases are usually needled. If the contents of the capsule are of a milky consistency, needling usually does well. The patient should be put through the same treatment before and after operation as in the case of Daviel's operation; and if a child, it is necessary to administer a general anesthetic.

Any of the various needles will do, but a Graefe knife is the best, used as a needle. It should be inserted at the sclero-cornea, driven

sufficiently across and sweep the radius of a circle, the point of puncture being the center, the point being used to sweep through the capsule and well into the lens from side to side, when it is withdrawn.

Some advise using a knife to cut right through the lens, posterior capsule included, which implies opening into the vitreous. There is no objection to opening up the vitreous in this way and I think the lens matter would be more readily absorbed; but there will be an after-cataract of a dense nature to deal with later on, in all these youthful cases; having opened up the vitreous complicates the already troublesome after-cataract operation, and on this account, the procedure is not advisable.

There is a class and a pretty large class of cataracts in youths, especially in children, in which the lens substance is of a jelly-like consistency, and which the experienced surgeon can detect before operation. I have known many cases of this kind needled six or seven times and even then, the lens matter remained unabsorbed. For this reason among others, all such cataracts in youth should be extracted by Daviel's method. Make a sclero-corneal wound, do an iridectomy, lift a large piece out of the front of the capsule and with free massage, squeeze the lens matter out of the eye. A small incision is sufficient as there is no nucleus in these cataracts.

AFTER CATARACT: Later on—not earlier than two months, and preferably six months after

operation—the writer makes an incision similar in size and position to that for an iridectomy, passes in an iris repositor, (the patient being well under atropin) and separates any attachments there may be of the iris to the after-cataract. Then pass in a good iris forceps closed, well beyond the center of the pupil, and allow the blades to dilate, directing the points backwards and drive them right through the after-cataract and fetch out what is in their grip, which implies that generally the whole after-cataract is removed.

If we do not succeed in bringing it all out in this way, we remove most of it. Such procedure would generally be called very drastic and dangerous; but any surgeon who sees it done and then sees needling done, if not already prejudiced, will, I have not doubt agree with me that the method I advise is much more “surgical” than needling. I can positively state that it is not followed by the sinister consequences which so often follow needling, which again implies that it is much the more surgical procedure of the two.

The flare-up which frequently follows needling is due in many cases to interfering much too early after extraction. In any case it is generally associated with increase of tension and considerable pain. If there is any increase of tension, the aqueous chamber should be tapped once, or even twice; if necessary daily for a few

days. If tension is not kept down in this manner the eye will certainly be lost.

It is usual to advise needling about a fortnight after operation, on the ground that the after-cataract is more easily lacerated then than it is several months later. In no case should an after-cataract be interfered with until well after every trace of irritation has disappeared. The disasters are almost all in the cases interfered with early. The case should be regarded from every point of view as a major surgical operation. If the disasters associated with needling were published, it would be found that they are many. If it were the simple proceeding unassociated with risk which the advocates of Daviel's operation wish us to believe, why do they not needle all their cases? As a matter of fact they are satisfied with poor vision rather than take the risk.

CHAPTER IV

Intracapsular Operation

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All operators today admit that the ideal extraction of cataract is in the capsule. When we consider the matter calmly, this is surgical common sense. By this means the whole offending body is removed, whereas, by the capsulotomy method only part is removed. When a wend of the scalp (which is assumed to be a diseased sebaceous gland) is removed, there is always a great deal of trouble if there is a trace of the capsule left, whereas, if the capsule is removed entirely, there is none. The same holds good in allied conditions.

If the capsule and some lens matter is left behind, there is an after-cataract as an invariable sequence and very frequently iritis also, both of which vary in their severity. When the lens is removed in its entirety, there is no after-cataract and very rarely iritis. In consequence, better vision is obtained, with less risks than an after-

cataract operation entails. Thus, intracapsular extraction has the great advantage that the normal lens can be extracted just as easily as the mature cataract. It follows that cataract at any stage of maturity can be extracted, thus saving the patient from having to wait for years, blind and unfit for work until it ripens. This is an asset of tremendous importance. These claims are seductive, and though intracapsular extraction may be repeatedly and strenuously opposed, it will return again and again until it obtains recognition.

HISTORICAL: When, where, and by whom the first intracapsular extraction for cataract was performed, is not known. Doubtless the delivery was unintentional. In other words the first operator was the patient himself; he it was who repeatedly impressed on the surgeon, by squeezing out the lens entire in defiance of the original intention, that this was the proper method of operating for cataract.

Samuel Sharp, (1700-1778) delivered the lens in capsule. A. C. Richter (1742-1812) in 1773 passed a needle through the sclera, impaled the lens and manipulated the instrument in such a way as to dislocate the lens. The lens and its capsule were then forced through the pupil, into the anterior chamber and were delivered through a lower corneal section without iridectomy. LaFay, Paris (1752) was the first to suggest a knife with which to make the corneal incision. J. J. Von Mohrenheim (1781) sug-

gested that all cataracts be delivered within the capsule after completion of the corneal incision. G. J. Beer, (1763-1821) in 1799 revived Richter's operation. Christiaen (1845) expressed the lens and capsule by finger pressure upon the upper eyelid. Sperino, Torino, Italy (1857) made a semi-lunar cut in the cornea and then incised the capsule. Few writers mentioned the subject until Pagenstecher (1828-1879) in 1866 and later his brother Herman (both of Wiesbaden) described their operation of extracting cataract in the capsule by lifting it out on a spoon.

The first American surgeon to advocate and practice intracapsular extraction of cataract was Dr. J. W. Wright, of Columbus, Ohio, whose earliest publication on the subject dates from 1884. He succeeded in expressing the capsule covered lens in about one-third of all his extractions. It is to be regretted that his work did not attract more attention after this date.

We must at this stage turn to India for the further development of intracapsular extraction. M. C. MacNamara of Calcutta, whose manual of the diseases of the eye appeared in 1868, described the advantages of the intracapsular method. In 1882 he states that he followed this procedure since 1864 and says, "I am convinced that if it were possible in every case in which we operate, to remove the lens in its capsule without damaging the other important structures of the eye, we should have reached perfection in the extraction of cataract."

Lt. Col. Mulroney of Amritsar, in the Punjab, was the first surgeon who performed intracapsular extraction of all kinds of senile cataracts, as a routine procedure. Unfortunately, he did not publish his method, which however, is described by his assistant, Rai Bahador Mehr Chand, in the proceedings of the Calcutta Medical Congress, 1894. It is essentially the same as Wright's method. I never saw Mulroney operate, but observed the after results in cases he had operated. I also noticed the excellent visual results in patients who had themselves squeezed out the lens in its capsule and proceeded to imitate the accident. The result is an operation for the extraction of cataract at any stage of its development with instruments and technique which are different from anything done by anyone else.

VARIETIES OF INTRACAPSULAR EXTRACTION:

There are three general divisions:

- 1st. Suction operations.
- 2nd. Expression operations.
- 3rd. Modifications of these procedures.

SUCTION OPERATIONS: Extraction of the lens in its capsule by means of a suction apparatus was first done by Dr. Vard Hulen of San Francisco, in 1910. He adopted the new principle of fixing the lens with a small vacuum cup and gently lifting the cataract contained in its capsule out of the eye.

He reported six successful cases. Recently

(1917) Barraquer of Barcelona, working with improved apparatus, has adopted the suction operation as a routine procedure and has reported 1000 cases. He has given the name *Phakoerisis* to the operation and *Erisiphako* to the apparatus used.

Theoretically the suction operation seems to be an ideal means of intracapsular extraction of cataract. Practically the apparatus often fails at the critical moment. The vacuum may be broken just as the lens begins to engage the corneal incision, and the delivery must be made by another method. In the hands of Barraquer the operation is a great success. In the hands of others, the method may often be unreliable.

The instrument requires a technique of its own. The suction method of the intracapsular extraction is yet in its infancy. Possibly in the near future, such improvements may be made in the *erisiphako* that it will be possible for many surgeons to use it.

EXPRESSION OPERATIONS:

Various methods have been advanced for the expression of the cataractous lens in its capsule. Only the Smith method will be exhaustively described.

THE JULLUNDUR-SMITH OPERATION

The mechanics of intracapsular extraction by this method and that of Dr. Barraquer, which in casual thought seem so different, are in reality the same in these cases amenable to both procedures, namely, the hard senile cataract and the immature cataract. (Smith's method covers the whole range of senile cataract, while Barraquer's does not seem applicable to Morgagnian and to all the class with liquid cortex.)

Apart from such cases the mechanics of both proceedings is to cause the lens to swing around on its transverse axis until the suspensory ligament gives way opposite the middle of the wound. Barraquer's instrument, (which has a suction grip on the front of the lens) is now used to extract the lens.

By Smith's method, pressure is made on the lower third of the lens, through the cornea, at right angles to the surface of the lens, to make it swing around on its transverse axis until the suspensory ligament at the wound gives way. The pressure is continued from the first at right angles to the anterior surface of the lens.

It follows that at the start, the pressure is directly backward, then backward and upward, then less backward and more upward, then upward until it is out of the eyeball. This pressure is made with a squint hook.

These changes in direction of pressure are im-

perceptible, a gliding of one into the other, all being under control of the finger muscles. No muscle of the forearm should be used in any cataract operation. Muscles of the hand are for light and versatile movements. Muscles of the forearm are for much coarser movements and for movements which do not require such quick and light control as those for which the hand is designed.

Dr. Barraquer is to be congratulated for the thought, energy, and skill which he has brought to bear on the subject; we wish him every success in the further development of his instrument as it may seem to require, but we hold that the mechanics of his method and of the Smith method are the same. It is yet to be seen if the Barraquer method will accomplish the end in view, as well as Smith's method in the class of cases for which it is suitable. It may never be as effective in cases of emergency which so often arise; cases in which Smith's method has to be brought into action to finish when it has failed.

If the operator has the mechanics of Smith's operation in his mind's eye, his incision 180 degrees, commencing in the sclero-cornea, and ending where he fancies, namely, in the cornea, sclero-cornea, or with a conjunctival flap, and if he commences on cases over fifty years of age, there is no reason why he should not succeed.

AGE OF PATIENT: The lens is easily dislocated in patients over sixty years of age, not so easily in those between fifty and sixty. Less easily

still between forty and fifty years of age; difficult in those between thirty and forty; exceedingly difficult between twenty and thirty; and under twenty impossible.

MORGAGNIAN CATARACT: In Morgagnian cataract and in those cases in which there is much liquid cortex, and a small nucleus floating in it, the capsule is always very weak and friable. Under any suction or Kalt forceps method, the capsule may give way. By Smith's method, these cases are the easiest of all cataracts to extract in capsule.

The cornea is so much thinner and so much more flexible than the sclerotic, that when we draw the point of the squint hook toward its periphery below, we are able to get a grip on the more rigid sclero-corneal ring (Fig. 140). Sufficient pressure is maintained on this ring to enable one to maintain his grip and make traction towards the patient's feet. In this manner one will succeed in dislocating the lens in its lower segment.

Dislocation is indicated by the lens rolling up (the small nucleus not preventing it from molding) when it rolls half way up. The direction of the pressure is altered to fold the cornea behind the lens by pressing the point of the hook in the fold of the cornea (Fig. 140a). When it is folded completely behind the lens, it falls back on the outside of the cornea, its suspensory ligament at the middle of the wound not yet being dislocated (Fig. 140b).

The squint hook is slipped underneath the lens at the same time with its concavity toward the lens, it is drawn along the wound and thus completes the dislocation (Fig. 135). These lenses will dislocate at the wound as easily as any other, but have a great tendency to burst when half out, in which case the capsule flashes back and is very difficult to recover again and to extract.

If the lens is made to tumble as above advised and yet bursts, it is then dislocated on the lower half and is thus lying at or near the wound. If the wound be milked with a pair of ordinary dissecting forceps, it is at once caught and brought away (Fig. 146).

SPATULA: If in the harder, or immature cataract, vitreous should appear before lens is out, then a spatula should be slipped behind the lens, not to lift it out, but merely to support it (Fig. 144). The squint hook should be pressed backwards so as not to be aimed at the end of spatula, but to pass a few millimeters beyond the end of it, then the lens will be seen to slide at once up the spatula. The handle of the spatula should be moved forward at this time so as to allow the blade to make way for the lens, the squint hook following up to make it slide out.

If this manoeuvre be done dexterously, vitreous should not escape, nor should there be any injury to the lens capsule. This manoeuvre should be practiced on the newly killed kitten's eye, which has been mounted as advised by Dr.

W. A. Fisher, of Chicago. Before mounting the kitten's eye, it should be given a good squeeze in the optic nerve area, so as to dislocate the lens, a thing that can be accomplished every time with a little practice.

The lens in capsule can be extracted without an iridectomy as easily as with an iridectomy; but the latter is advised because of the liability to prolapse of iris. The pillars of the coloboma should be carefully replaced from the angles of the wound.

IRITIC ADHESIONS: In the case of posterior synechia (even though complete) do an iridectomy and proceed as in the ordinary case.

The synechial adhesions are so weak that they give way and seldom cause any trouble. If the operator is afraid of trouble, he should insert an iris reposer where he has done the iridectomy and forcibly separate the adhesions.

The operation is rendered practicable by the aid of an assistant who will draw the lower lid down with the face of his left thumb, applied over a little cotton wool, just below the margin of the lid. With a large sized squint hook (two or three times normal size) between the index finger and thumb of his right hand and about one and a half inches from the hook, the assistant lifts the lid forward at right angles to the vertical plane of the head, and at the same time, with the back of the ends of the remaining three fingers, presses back the brow so as to lift the whole of the orbicularis muscle and the redundant tissue

of eyelid and brow out of action (Fig. 117). He should retain his hold until the operator tells him to let go.

Before the assistant is told to let go, the patient should be told to close his eye. The operator knows that he understands when he makes an effort to roll up his eye. Then, and not until then, the assistant is told to let go.

The assistant is not proficient until he can expose the whole fornix.

In the control of the orbicularis, this operation differs from all of its predecessors. This control implies very much less escape of vitreous and much more deliberation at each step, as the operator is not at the mercy of the patient.

SPECULUM OR RETRACTOR: As regards the use of a speculum or retractor while making the incision, the operator should use his own judgment. A screw speculum is an abomination, as it cannot be taken out at a moment's notice, as is occasionally required. In patients who are likely to misbehave, a retractor is infinitely preferable. With it the patient is under control. The reverse is the case with a speculum (Fig. 131).

CHAPTER V

Intracapsular Operation

DR. H. T. HOLLAND, M. B., F. R. C. S. E
SHIKARPUR, SIND, INDIA

SELECTION OF THE PATIENT: At the outset let me say that although in my opinion, certain types are more suitable for cataract operation than others, yet when all is said and done, if a patient has an operable cataract, there is only one thing to be done and that is to have it out. If the cataract is mature, the cataractous eye is to all intents and purposes useless; and, even should the operation not prove successful, the patient will be no worse off than he was before. It is for this reason that the cataract operator must be prepared to take certain risks and operate in some cases where the hope of success is apparently not very great, provided there is even a slight chance of restoration of vision to the affected eye.

A word or two as to selection of cases is however, not out of place; and the young operator, who has to make a reputation for success in this

field, would be well advised to decline all doubtful cases and confine his attention in the first instance to carefully selected cases, which offer a fair prospect of success.

1. **OCCUPATION:** I have found with few exceptions that the country labourer and field worker is the ideal patient on whom to perform cataract extraction. He or she, as the case may be, has led a healthy out-of-door life; and has probably not indulged in alcohol or in any of the other debilitating vices associated with city life. He probably does not know the meaning of "nerves" and gets on the operating table often without the slightest qualm. The city man on the other hand has spent but little time out-of-doors, has lived a great part of his life in a shop, factory, or business house, has very possibly indulged in alcohol, often to excess, is a bunch of nerves and jumps as soon as the speculum is placed in his eye. Not only does he give much more trouble to the operator at the time of operation, but the corneal wound does not heal as rapidly. The eye remains red, perhaps for some time after operation and iritis is more apt to occur because his tissues are not in such healthy condition as those of his more fortunate brother, the tiller of the soil.

SEX: There is not much to be said under this head, but as a rule I have found women more placid and better patients than men, possibly because they have learned to suffer more in child-bearing and other ways than men.

AGE: In India, whatever be the cause, cataract occurs at a much earlier age than in the West. Many cataract operations are performed on patients under 40 years of age. I have found it the general rule that the younger the patient, the more unsteady he is and less tolerant of operative interference with his eye. Not only is the young patient less tolerant of operative interference, but in the vast majority of cases of cataract in the young, the zonula is much more difficult to rupture, and hence, owing to greater force being employed, there is greater danger of loss of vitreous.

Experience has led me in these cases to adopt the following procedure: I first attempt to extract in the capsule, but if immediate pressure does not succeed in rupturing the zonula and cause the lens to present, I then re-introduce the speculum and extract the lens with capsulotomy. It is in cases of this kind that damage is done by exerting too much pressure in attempting to rupture the zonula.

TYPE AND GENERAL BUILD: The ideal patient is a placid individual of the age of 60 or thereabouts. I am suspicious of the plethoric type, the red faced corpulent patients, especially if they show a large protruding "ox" eye. In these cases I have found a much greater tendency to escape of vitreous, the bug-bear of the intracapsular operator, and in such cases I often recommend capsulotomy to be performed.

In addition to the above there are other considerations of varying importance to be taken into account in selecting an eye for cataract operation.

I will pass over without further comment the more obvious contra-indications for extraction of cataract, such as purulent conjunctivitis, dacryocystitis and any septic condition of the nose and orbit; but I would like to draw particular attention to the question of pyorrhoea, especially in its more aggravated forms. On several occasions, I have noticed eyes do badly after cataract extraction and have looked into the patient's mouth only to find a number of carious stumps with pus exuding from the gums. In India where pyorrhoea is so prevalent, attention should always be directed to the state of the mouth, as sepsis can readily pass up through the nose and lachrymal duct to the eye.

TRACHOMA: This is not in my opinion a contra-indication to cataract extraction. In India, trachoma is exceedingly common and yet we operate on many trachomatous eyes, after flushing out with 1-2000 hydrarg. perchloride lotion, and find no bad results ensue. If there is any purulent conjunctivitis associated with the trachoma, then four or five days treatment with silver nitrate gr. XX to the ounce, applied to the lids, followed by two days treatment with protargol or silvol gr. XX to the ounce, instilled two or three times a day, usually makes the eyes safe to operate upon.

GLAUCOMATIC CATARACT, and CATARACT IN GLAUCOMA: Col. Smith in his book deals fully with this subject. By glaucomatic cataract he means cataract which has glaucoma as its cause, due to the increased intra-ocular tension which interferes with the nutrition of the lens. In these cases operation is seldom justifiable and rarely successful. But each case must be decided on its merits and if there is some reaction of the pupil to light and some perception of light, there is hope. In such cases a wide iridectomy, followed by extraction of the lens in three or four months, is occasionally followed by marked success; and I have seen two or three such cases. But when I do extract, I always do so by capsulotomy. In these cases I perform a capsulotomy because I think the more gradual extraction of the lens, when extracting with capsulotomy, reduces the intra-ocular tension more gradually, and with less likelihood of being followed by choroidal haemorrhage.

CATARACTS IN GLAUCOMA are defined by Col. Smith as "cases in which glaucoma has set in during any stage of the normal development of cataract." Here again if there be reaction of the pupil and perception of light, when the cataract is of intumescent variety, as Smith says, the best procedure is to extract the lens performing a wide iridectomy at the same time, after giving a free calomel purge for the two preceding days. But I do so by capsulotomy for the reasons stated under Cataract in Glaucoma. If

the cataract is not of the intumescent variety, then a wide iridectomy, followed three months later by extraction with capsulotomy is I consider the safest course, for here an attack of acute glaucoma is not so apt to occur as in the case of intumescent cataract in glaucoma.

GENERAL DISEASES: Such as Diabetes, Bright's Disease, Gout, Atheroma, and Arteriosclerosis.

In the case of diabetes, a preliminary course of treatment to reduce the output of sugar as far as possible, and to improve the patient's general condition, is advisable, after which the cataract can be extracted with comparative safety; but the patient should be warned that his chances of success are not as great as in a non-diabetic. Healing of the wound is apt to be delayed and for this reason a small conjunctival flap is beneficial to insure a more rapid union of the corneal wound.

In Bright's disease, gout, atheroma, and arteriosclerosis, as well as all other conditions where the blood pressure is raised or the blood vessel walls tends to be more brittle than normal, choroidal hemorrhage is more apt to occur and for this reason the administration of a mercurial purgative for two days preceding the operation is a useful safeguard.

ANESTHESIA: It is my practice to use cocaine solution, gr. XX to the ounce, which is instilled three times at five-minute intervals. Col. Herbert, (retired I. M.S.) continued instilling cocaine

until it brought about its full mydriatic effect and the pupil dilated, as he then had full confidence that the cocain had made the iris insensitive. I feel convinced that if this practice was the more usual routine among eye operators, accidents on the table, due to the patient flinching and suddenly moving his head as soon as the iris is grasped by the iris forceps, would be very much reduced. I have twice seen the whole iris come away, owing to the patient suddenly jerking his head almost off the table as soon as the iris was seized.

Should the patient be very nervous and "jumpy," it is advisable to give a large dose of bromide gr. XXX or XL. two hours before the operation; and if even after this treatment, when he gets on the table, he should appear intolerant of any manipulation of the eye, the operator would be well advised to give a few whiffs of chloroform stopping short of full surgical anesthesia, rather than court disaster, by the patient violently squeezing his eye and extruding the lens and very probably a considerable quantity of vitreous with it.

INSTRUMENTS AND THEIR CARE: It is our usual custom to boil all instruments, except the cataract knife and iris scissors, for at least twenty minutes, after which the tray in which they have been boiled is lifted bodily out of the sterilizer and placed in a larger tray containing boric lotion. Our sterilizer contains three such trays made of tin with perforated bottoms arranged

side by side with handles to lift them. We have also a pair of hooks to lift these trays; and after each operation the tray with the used instruments is replaced in the sterilizer and one of the others which has been boiled is taken out for the next operation. In this way there is no handling of the instruments by the assistant.

The cataract knife and iris scissors are kept in rectified spirit on an oval tray and are dipped in boric lotion before use.

With care we have been able to perform as many as seventy-five corneal sections with one cataract knife, but this is the exception, twenty being the usual number for each knife.

The instruments used are two strabismus hooks (Smith's), that for holding the upper eyelid being one-half inch longer than that for delivering the lens. Fisher has an excellent lid elevator, which I have also used and which has some advantages (Fig. 124).

FIXATION FORCEPS: The fixation forceps used are those without a catch; Smith strongly recommends those with two teeth in one jaw and three in the other. They are in my opinion the best pattern.

SPECULUM: I always use Smith's spring speculum, with no screw or fixing mechanism.

KNIFE: Smith's modification of the Graefe's knife, with a straight back, is, in my opinion, the best pattern made.

IRIS SCISSORS: Smith prefers an ordinary pair of iris scissors curved on the flat. Personally I

prefer a De Wecker's scissors and always use them. With the latter I find it much easier to perform an iridectomy if the patient rolls up his eye under the upper eye-lid than with the ordinary iris scissors. This does not occur to such an extent when the conjunctiva is seized with fixation forceps by an assistant, but I perform the iridectomy in over 95 per cent of cases, without having the eye seized and steadied by a fixation forceps.

SMITH'S IRIS REPLACER and SMITH'S SPOON—as shown in illustration (Fig. 137, 133).

IRIS FORCEPS: Any form curved, but not straight.

LARGE DRESSING FORCEPS—for removing capsule when it bursts (Fig. 141).

NEEDLE: Any of the ordinary needles used for congenital cataracts. I always like to have one handy, as in some cases when the lens sticks at the corneal wound (particularly if the lens is very large or the corneal wound unfortunately small) a gentle revolving of the lens with the needle will succeed in delivering the lens at once. Fisher has introduced a special needle for this purpose which he describes in a paper read before the Chicago Ophthalmological Society, March 15th, 1915. (Fig. 133.) He uses it especially when there is threatening or actual loss of vitreous (Fig. 145). I have never used it for this purpose, but only in the occasional cases when the lens sticks in the wound and fair and legitimate pressure does not succeed in delivering it.

PREPARATION OF THE PATIENT: I am completely in accord with Col. Smith's views on this subject, that the less done in the way of preliminary preparation the better. The more the patient's attention is directed to the impending operation, the more likely he is to develop "nerves" at the time of the operation. In 95 per cent of cases our patients are put on the table with no preliminary preparation whatever.

I cannot do better than quote Smith in this connection—"The operator should take his patient as quietly as possible and ask no favors of him, but proceed to operate in whatever position the eye happens to assume. The more he talks to the patient, the more nervous he makes him and the more unintentional trouble he will give him." All eye operators recall the absurd efforts a patient makes to look in the proper direction, which often end in rolling his eye around all the points of the compass.

It is here that the intracapsular operation is so immeasurably superior to that of capsulotomy; In the intracapsular operation the lens is most readily and most safely delivered, when the patient looks up, this being the position the eye naturally assumes during rest or sleep.

The patient having been placed on the table not less than fifteen minutes after the eye has begun to be cocaineized, the question arises as to what should be done regarding the cleansing of the skin of the eye-lids and their neighborhood. It is perhaps advisable to wash these parts with

a little ethereal soap followed by 1-30 carbolic as recommended by Smith; but my experience has led me to believe that this is not necessary, as the free douching of the eye with 1-2000 perchloride of mercury not only cleanses the conjunctival sac and the lids but also the cheek, nose, and all the skin in the neighborhood of the eye.

The douche I use, as recommended by Smith, is an ordinary douche can holding two pints of lotion, connected with a long rubber tube and broad nozzle, $1\frac{3}{4}$ inches in diameter. This is placed four to six feet or more above the patient's head and the stream is made to play with considerable force on the eye, so that the douche will have some mechanical effect in removing any foreign substances, mucous, etc., from the conjunctival sac. My practice is first to douche out the eye without inserting the speculum, everting both lids, then pressing together the free margins of the lids thereby squeezing out the contents of the Meibomian glands, finally pressing firmly with a finger or thumb over the caruncle to express any mucous or discharge the canaliculi lacrimali may contain.

After the initial douching, I introduce the speculum and once more douche the eye, moving the speculum with a rocking motion up and down; I also turn the nozzle upward directing the flow of lotion upwards beneath the upper lid, thus enabling the fluid to reach both fornices. This double douching has also the effect of thor-

oughly sterilizing and cleaning the skin in the neighborhood of the eye.

OPERATION: The patient should lie on the operating table without a pillow. Many operators prefer a flat table, but I prefer one which has a slightly inclined plane at the upper end. This is a matter of no importance and each operator must decide according to his own preference. Some operators prefer operating in a sitting position, but most operate standing.

AMBIDEXTERITY: If the right eye is to be operated on, the operator should stand directly behind the patient's head. In the case of the left eye, should the operator be ambidextrous, he will operate with the left hand and stand behind the patient's head, but, in the vast majority of cases, the right hand is the better of the two, and it is advisable to operate on the left eye with the right hand, for which purpose the operator stands on the left side and in front of the patient in making the incision. If the operator is left handed, the left hand is used for making the incision.

Fisher recommends the use of special lid retractors to separate the lids from beginning to the end of the operation, but I have always used the Smith spring speculum, without screw fixation which is of great advantage if the patient should squeeze. When the speculum is fixed by a screw mechanism, it acts as a point of support for such squeezing and may result in a large and serious loss of vitreous. For the same reason I prefer a speculum with a very weak spring, so that as

soon as pressure is exerted the two limbs of the speculum at once come together.

Colonel Smith in his excellent book gives the best advice possible regarding the holding of the knife and catch forceps.

"In making the corneal incision as well as in performing the iridectomy, both hands of the operator should rest on the patient's head. It is almost impossible to keep both hands steady, unless they find support on the head of the patient." This also enables the operator to control the movements of the head of the patient, as Col. Smith wisely points out. The left hand which grasps the toothed forceps should rest on the left cheek and similarly the right hand which grasps the knife should rest on the right side of the patient's head as Smith describes "the back of the terminal joints of the little finger should rest against the front of the temple and the ring finger should rest on the little finger and against the temple."

It is very important that the conjunctiva should be grasped as near as possible to the limbus, as in this position the conjunctiva is much less liable to give way. Many an incision is spoiled owing to the hold giving way when the patient rolls up his eye under the upper eye-lid; besides, it is extremely difficult to complete the incision properly, for, by the time one has grasped the conjunctiva again, the anterior chamber may have collapsed, due to escape of the aqueous, and the incision is completed often

with great damage to the iris, which falls over the blade of the knife.

The point of the knife should enter at the sclero-corneal margin, except in the case of those with very small corneae, when the point of the knife should enter slightly externally to the sclero-corneal junction. The point of the knife should enter at almost right angles to the cornea, in order to insure sufficient depth in the incision and to prevent any splitting of the cornea.

The second important point is to grasp the conjunctiva as high up as possible, affording thereby much more purchase and much more room. An operator is often seen in great difficulties through taking too low a grasp of the conjunctiva, owing to the fact that when the patient rolls up his eye, he cannot bring the upper part of the cornea into view, as it has disappeared under the upper lid.

INCISION: To illustrate this I would like to refer to Smith's excellent chapter on the treatment of cataract and his illustrations, showing how the incision should be made. "The knife should be held very lightly, as one would hold a pen and at a good distance from the blade. The right hand should be used for both eyes even if the operator is ambidextrous, because the patient has a right to the operator's best hand; when operating on the left eye, the operator will therefore stand at the left side and in front of the patient.

As soon as the point of the knife has penetrated the entire depth of the cornea, the handle of the knife should be lowered until it occupies a horizontal position; it is then thrust right across the anterior chamber and made to pierce the sclero-corneal junction exactly opposite the point of entrance, the blade being driven across the anterior chamber on the flat."

Smith recommends that when the knife point touches the opposite side of the sclero-cornea, the operator should twist the knife slightly on its back, that is, at an angle of about 45 degrees, and drive it through, and when the point is through, bring it again on the flat. This is done in order to prevent splitting of the sclero, but at the same time it insures against the point of the knife coming out too deep.

When the point of the knife has emerged, the knife should be inserted to the hilt and the greater part of the incision should be made by one forward sweep, the incision being completed by a single backward sweep of the knife, thus making a clear cut, not one with ragged edges, as is apt to occur if the incision is made by a sawing motion from side to side.

To perform this incision satisfactorily, the handle of the knife must be depressed and the point directed over the bridge of the nose; this will insure the knife blade being driven through to the hilt, and prevent the point pricking the eye in the direction of the canthus, thereby causing the patient to wince. If he is in any way

nervous, I always make my assistant draw up the eye-brow with the thumb of his right hand, to prevent squeezing and extruding the lens. In these cases I also make the incision slower, as I have found that patients are less apt to extrude the lens if the incision is made in a more deliberate manner.

IRIDECTOMY: The corneal incision completed, the iridectomy is next done. Here I do not follow Smith's procedure, excellent though it is, but introduce the points of the iris forceps into the anterior chamber, grasp the iris and by a quick snip with the De Wecker scissors, cut off the necessary portion of the iris. In 95 per cent of cases I do not have the conjunctiva held by an assistant, with the toothed forceps, this being done only in very nervous patients who roll their eyes about and seem unable to keep them steady for even a couple of seconds.

Unless the assistant is one of great experience, in the event of the patient squeezing or attempting to move his head, he is inclined to hold on to the eye too long and there is apt to be an escape of vitreous. The assistant is also apt to press on the eye instead of lifting up the conjunctiva at the sclero-corneal margin and this again tends to an escape of vitreous.

On the whole I have had fewer accidents owing to not having the conjunctiva grasped than by having it grasped. I have met but few assistants, who understand grasping the conjunctiva

properly and who release the grasp quick enough in the case of an emergency.

Performing the iridectomy by a very sharp, quick snip with De Wecker's scissors, I find I can generally catch the patient unawares, when he is not expecting it and the iridectomy is thus completed before he has time to wince; whereas, when the conjunctiva is firmly grasped, the patient realizes that something is about to be done and is more liable to wince or move his head.

EXTRACTION: The iridectomy having been performed, the speculum is removed and the care of the eyelids is handed over to the assistant. The position of the hands is exactly illustrated in Smith's book (Fig. 117).

The upper lid is lifted forward on the blunt hook retractor, which is held between the assistant's thumb and index and middle finger, while the ring and little finger of the same hand is used to draw back the upper eye-brow, thus controlling the orbicularis muscle. The lower eyelid is retracted by placing the thumb of the other hand flat on the skin of the face immediately below it and by drawing it down. Better control is obtained if a little dry sterile wool is placed under the face of the thumb.

In some cases it is difficult to obtain an assistant who can control both upper and lower lids and I have often made use of two assistants, one standing behind the patient controlling the upper eye-lid and lid hook retractor, the other crouching by the patient's side so as to be out of the

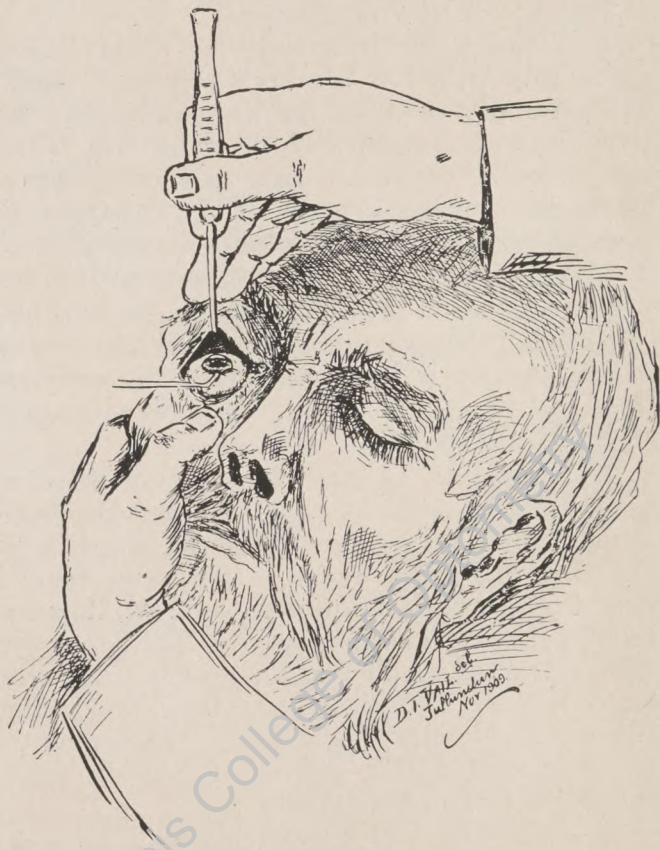


Figure 117.

Showing the proper position of the assistant's hands in holding the eye-lids, while the operator is expressing the lens in its capsule through an upward incision (notice how the eye-brow is being held up by the assistant's three fingers). The upper lid is hung on the lid hook exposing the summit of the eye-ball. The lower lid is everted by the thumb of the assistant's left hand.

way, his thumb drawing down the lower eye-lid. Provided the orbicularis is effectively controlled and the upper lid raised to provide a good view of the eye-ball, and that the assistants keep out of the way of the operator, it is immaterial where they stand. But the assistant must be in a position to see all that is going on and be ready, should any vitreous present, to alter his position and lift up the cul-de-sac of the upper fornix.

The assistant or assistants, as the case may be, having taken proper control of both upper and lower lids, the operator next proceeds to dislocate and extract the lens. He takes the spatula in the left hand, it being my custom to place the end vertically on the sclerotic just below and to the left of the sclero-corneal junction between four and five o'clock. This is lower down than Smith recommends, but it is the position I find most useful for dislocating the lens. With the right hand the operator takes the blunt hook. Both hands should be supported on the patient's head. This will ensure greater steadiness and delicacy of movement on the part of the operator.

The spatula having been applied as stated above, the ball end of the hook is applied to the lower third of the cornea and gentle pressure made with both instruments in position. The spatula at this stage being kept quite stationary and used chiefly to steady the eye-ball, the ball end of the hook is pressed on the lower third of the cornea, pressure being, as Smith describes, straight backward toward the optic nerve.

If the lens does not show signs of being dislocated into the corneal incision, the ball end of the hook is made to pass slightly from side to side; these side to side movements generally succeed in dislocating the lens. The position of the spatula on the cornea must not be moved, and a steady pressure must be maintained. Should legitimate pressure not succeed in dislocating the lens, I then tell the assistant to release his hold of the lids and I insert the speculum and extract in the ordinary method with capsulotomy.

Experience alone will enable the operator to know when, what I call legitimate pressure, has been made. I find that I have to re-introduce the speculum and perform capsulotomy in only about three per cent of cases; but I believe that if capsulotomy was always done in the three to five per cent of cases in which there is great difficulty in dislocating the lens, the disaster of the lens finally coming out with a rush and a large escape of vitreous with it, would not occur so frequently.

I have generally had occasion to regret when I persisted in increasing the amount of pressure in those cases in which it was difficult to dislocate the lens and have never regretted relinquishing the pressure, re-inserting the speculum and extracting with capsulotomy.

In regard to the extraction in the 97 per cent of cases in which the lens is dislocated without undue pressure: As soon as the lens appears at the corneal incision, the spatula is kept in the

same position while the ball end of the hook is used to follow the lens up, the same side to side movements being employed, but the pressure now instead of being straight backwards toward the optic nerve is made in an upward direction towards the incision. This is done by rotating the handle of the hook, so that the back of the hook looks backward and the ball points towards the corneal incision. After two-thirds of the lens has appeared at the incision, the pressure may be greatly reduced, as the lens then will almost deliver itself and can be hooked out; any undue pressure at this time may result in rupturing the capsule of the lens. This accident will be referred to later on under accidents occurring during the operation.

While the lens is being delivered at the incision, gentle pressure only is exerted, tucking the cornea under the lens, so that at the conclusion of the operation the cornea is in its place and will have fallen back.

TOILET: After the lens has been delivered, special care must be directed to the iris, because unless it is properly replaced, the pupil is apt to be U-shaped, owing to the edge of the iris being entangled at the angles of the incision.

Replacing the iris may be done with the hook, sweeping the ball point of the hook right around the incision from side to side, and paying special attention to the angles of the incision. Or Smith's iris reposer may be used, as with this it is easier to detach the iris from the angles of the incision (Fig. 137).

Smith draws attention to the fact that more care must be given to the base of the iris, as the pupillary margin will look after itself.

Another detail of importance and yet one which is frequently overlooked, is that in performing the iris toilet, all movements of the iris repositor should be made from the angles of the incision toward the center and not vice versa; otherwise, instead of detaching the iris from the angles of the wound, the operator incarcerates it more firmly than before. However, I have on several occasions seen operators sweep the iris from side to side toward the angles of the incision.

TUMBLERS: This term refers to those cataracts in which the capsule is very apt to burst if dislocated at the incision first. They can be extracted with greater safety, by what is termed "tumbling"—that is to say, by making the lens turn a somersault. By this means that part of the capsule most distant from the incision is first dislocated, so that even if the capsule does burst when the lens is almost out, it does not matter so much; the capsule having been detached all around except near the incision, does not present such difficulty but that it can be easily caught and extracted.

Those cataracts that can thus be extracted are the mature, hypermature and intumescent. In fact these all contain soft matter, which admits of their being molded. Experience will enable the operator to decide which are "tumblers."

Should the operator be in doubt, he may attempt first to dislocate the lens below and if this fails, he may then have recourse to the technique followed in extracting by the upright method.

In tumbling a lens, the pressure with the ball end of the hook is made in a different direction, not straight backward toward the optic nerve, but downward toward the patient's feet, the point of the hook being placed about three millimeters from the sclero-corneal margin, just inside the ciliary ridge. This can be recognized as Smith points out, by the greater rigidity of the cornea at this point (Fig. 140). At this point steady pressure should be applied, pulling away from the region between the optic nerve and the incision, and pulling instead, toward the patient's feet.

As soon as the zonula breaks below, the lens will begin to roll over and come out lower side first. The operator should not release his pressure until the lens has passed the equator, when he should alter the direction of his pressure and follow up the lens, pushing it upwards as in extracting an immature lens (Fig. 140a).

Should the capsule burst, it can easily be extracted as it will hang outside the corneal incision.

COMPLICATIONS AND ACCIDENTS OCCURRING DURING THE OPERATION

A. THOSE THAT OCCUR DURING OR AT THE CLOSE OF THE CORNEAL INCISION.

I. EXTRUSION OF THE ENTIRE LENS IN ITS CAPSULE WITH OR WITHOUT VITREOUS: This occasionally occurs, especially in nervous patients who squeeze suddenly at the conclusion of the incision and drive out the lens with or without vitreous. In some cases, especially where there is no loss of vitreous, no harm may be done and a perfect result obtained. The speculum should be taken out as soon as possible and the eye-brow pulled up by the thumb of the assistant, while with the thumb of the other hand he pulls down the lower eye-lid, thus throwing the obicularis out of action. If there is no prolapse of the iris, the eye may be closed and dressed in the usual way.

Should there be a prolapse, the lid hook should be placed under the upper eye-lid and the iris replaced by the iris reposer; or a small iridectomy performed. Should there be a prolapse of vitreous, this should be cut off with a pair of scissors curved on the flat.

II. DISAPPEARANCE OF THE LENS INTO THE POSTERIOR CHAMBER OF THE EYE: I have seen this accident occur thrice, and without ap-

parent reason. In one case the lens disappeared before the iridectomy was performed, and in the other cases this occurred after the iridectomy. In one case the accident occurred in both eyes in a case of binocular extraction. The operator called to me to tell what had happened and asked me to perform the operation on the other eye. I did so and the lens dipped and disappeared as soon as the iridectomy was performed. I directed both eyes to be bandaged for two days. Two days later the lens in one eye had floated up to its normal position and was easily extracted by Smith's method, placing the spoon behind the lens while with the blunt hook over the cornea the lens was made to slide up the inclined plane of the spatula. I repeated the same method in another case with a successful result.

B. COMPLICATIONS DURING THE PERFORMANCE OR AT THE COMPLETION OF THE IRIDECTOMY:

I. EXTRUSION OF THE LENS AS UNDER A: This is to be treated in a similar manner as above.

II. HAEMORRHAGE FROM THE IRIS: This does not often occur and is seldom of a serious nature. The blood in the anterior chamber can usually be milked out at the close of the operation by gentle stroking movements in an upward direction with the blunt hook laid on the flat.

III. TEARING AWAY OF A LARGE PORTION, EVEN THE WHOLE OF THE IRIS: This is generally due to the patient moving his head vio-

lently and dragging the iris from its attachment. If it occurs the ragged edges should be cut away as well as possible.

C. COMPLICATIONS OCCURRING DURING THE EXTRACTION OF THE LENS:

I. FIXATION OF THE LENS AT THE CORNEAL INCISION: This is usually caused by too small an incision and may often be overcome by passing the blade of a pair of scissors into one angle of the incision and enlarging it.

Sometimes a very large lens may be delivered by impaling the lens on a needle and then rotating it on its antero-posterior axis. Elliott in his book describes the technique, as an action like that of turning a cart wheel on its axle, by seizing the tire and turning it around.

II. TENDENCY OF THE LENS TO DIP INSTEAD OF PRESENTING AT THE CORNEAL INCISION: Here all pressure must at once be removed from the outside of the eye and Smith's spatula held in the operator's left hand must be immediately dipped into the vitreous behind the lens and used only to support the lens, while he proceeds to slide it up the inclined plane of the spatula with the blunt hook held in the right hand over the lower part of the cornea, and so delivers the lens.

III. PROLAPSE OF VITREOUS: In this as in the previous case, no further pressure must be exerted in attempting to press out the lens, but

the spatula must be immediately dipped into the vitreous behind the lens and the lens delivered as described above under II, which can often be accomplished with no loss of vitreous. Should there be any loss of vitreous, the prolapse should be cut off with a pair of scissors curved on the flat.

IV. PROLAPSE OF VITREOUS AFTER THE EXTRACTION OF THE LENS: This is met by Smith's technique. When the assistant who has control of the lids, sees vitreous obviously presenting at the incision, he at once tilts the handle of his lid hook toward the patient's feet in order to lift the cul-de-sac of the upper fornix; in this way the vitreous by suction goes back within the globe and in some cases there is no actual loss of vitreous, or if there has been some, further escape is prevented. This is a manœuvre with which every assistant who holds the lids should be expert (Fig. 142).

V. CHOROIDAL HAEMORRHAGE: In some 8000 cases of cataract extraction I have seen this accident occur five or six times on the table. In two cases I have waited until the haemorrhage ceased and then cut away all the vitreous and blood clots and replaced the cornea; the incision has healed by first intention and the eye ultimately showed quite a good cosmetic result.

PLUS TENSION: I am inclined to think that choroidal haemorrhage in high tension eyes is more apt to occur with the intracapsular operation than in the capsulotomy operation, and this

year I had evidence of this in two cases. The patients came with double cataract, with tension plus, though not markedly so. In each case one cataract was extracted in the capsule and the other with capsulotomy. Though these were not operated on by me, yet I had the cases under observation. In each case the eye in which the intracapsular operation had been performed, had a choroidal haemorrhage, and the other eye in which the cataract had been extracted with capsulotomy escaped.

At the beginning of my chapter under selection of cases I have already referred to operation on eyes with plus tension, saying that in those cases there is less risk of a choroidal haemorrhage if the operation is performed with capsulotomy; what little experience I have had confirms me in that opinion.

VI. EVERSION OF CORNEAL FLAP OR TURNED SECTION: This occurs in my experience in two or three per 1000 cataract operations. In the Madras Government Ophthalmic Hospital report for 1920, there were 16 cases reported out of 1525 cataract operations, which is a considerably higher percentage. It is certainly not more common in cases operated in the capsule, but the reverse, as by far the greater majority of cases in the Madras Hospital were operated on by the capsulotomy operation. The cases reported on by the hospital authorities were treated by covering the whole cornea with a flap from above, and keeping on a pressure bandage for

two or three days. In six cases, a uniformly curved scar was obtained, in continuity with the curve of the lower half of the cornea, but all the cases remained in the failure group. Four turned sections were treated by stitching the lids, but this was not so satisfactory.

The treatment I recommend is different to the above and in one case fair vision was obtained. When, owing to prolapse of the vitreous, some difficulty is experienced in replacing the corneal flap, a note is made of the case and the eye is opened on the third day. If the flap is everted, the flap is turned back and the angles of the incision examined for any tags of iris, capsule, or vitreous, which act as a wedge to prevent the hinge closing, and when once this wedge is removed, the corneal flap has a fair chance of falling back. Whatever may be the cause of preventing the hinge from closing (usually vitreous) is removed with iris forceps and scissors, and the flap then usually falls back; but to keep it in position, the blunt hook is pressed on the flat over the cornea and the upper eye-lid closed down; then the hook is carefully withdrawn and a firm pressure bandage is applied. This technique but seldom fails. The flap usually remains opaque for some days but gradually clears up, though the upper portion may remain permanently opaque.

If the eversion is not discovered until the fifth day, some adhesions have usually formed and it is then more difficult to replace the flap. Even

then if any prolapse is cut off and the hinges, i.e., the angles of the incision, are carefully cleared, the case is by no means hopeless, though the prospects of vision are poor. In the case of the lower half of the cornea remaining clear, a lower iridectomy should be done at a later date.

VII. RUPTURE OF THE CAPSULE: Here considerable skill and quickness on the part of the operator is called for. As soon as the capsule is seen to have burst, the lens must be followed up and kept in position by the spatula, while with the right hand the lens and capsule should be seized with a pair of dissecting forceps and pulled out.

If the operator fails to extract the capsule by this means, he must re-insert the speculum and expel as much as he can of the capsule and cortex as in the operation with capsulotomy, and attempt to extract the capsule with a pair of iris forceps. Smith draws attention to the fact that the operator is very apt to pass the forceps behind the capsule. To avoid this the points of the forceps must be kept close to the under surface of the cornea and passed so as to reach as far as the lower portion of the pupil, and then, as Smith describes, the points should be turned backward, pressed back, closed and all that is within their grip brought out.

DRESSING AND BANDAGE FOR THE EYE AND AFTER TREATMENT: As soon as the iris toilet is completed a circular piece of boracic lint boiled for five minutes is placed wet on the eye, over

this is placed a circular piece of boracic cotton wool one inch thick, and on the un-operated eye a similar pad of lint and boracic wool, the whole being firmly bandaged with an ordinary roller bandage three yards in length and three inches in diameter. If there is no complaint of pain, the bandage is not opened until the fifth day; and if everything is well and no complications have occurred, the dressing is then changed, the eyelids being cleansed by a wet boracic swab of wool. The eyes are re-bandaged with a similar dressing and left for two days, when the bandage is again taken off and a green shade placed over the eye and in the ordinary course of events, the patient is discharged on the eighth or ninth day.

The patient is kept in the recumbent position for two or three days, but is allowed to turn on his side after twenty-four hours. The patient is kept on his back without turning for twenty-four hours, on account of the danger of choroidal haemorrhage, which may come on at any time within that period.

The patient should have a purgative after forty-eight hours, if there has been no movement of the bowels up to that time.

There are no particular restrictions regarding diet, except that it should be light, especially for the first three days, after which the patient may eat what he likes.

Regarding dressing the eye, on the fifth day there are two practical points to which I wish to draw attention. First: Do not attempt to

examine the eye with the patient in the recumbent position. He will roll up his eye under the upper lid to avoid the light and it will be extremely difficult to obtain a satisfactory view of the upper portion of the cornea. Make the patient sit up and the eye can be much more easily examined.

Secondly: As the patient tends to squeeze his eye or wince, the first time the eye is opened, always place the thumb of the left hand on the upper eye-brow and pull it upward to prevent the possibility of a prolapse of the iris or gaping of the incision, if it is not firmly united.

POST-OPERATIVE COMPLICATIONS

CONJUNCTIVITIS: This complication, which Elliot in his *Tropical Ophthalmology*, describes as being nearly always present in the operation with capsulotomy, is but seldom seen in those eyes which have been operated on in the capsule. We do not find it, at any rate in a degree which calls for treatment in more than 5 to 10 per cent of cases. When it does occur, protargol or silvol gr. X. to the ounce is instilled once or twice a day, after the shade has been put on.

ACUTE IRITIS AND IRIDOCYCLITIS: This which generally gives evidence of its presence on the third or fourth day, or sometimes even earlier, must be combatted at once, and that most energetically. The treatment consists of: (a) instillation of atropin gr. X. to the ounce of water, three or four times a day until the pupil dilates

fully; (b) application of leeches to the affected temple; (c) aspirin gr. XV. twice or three times a day. This will greatly relieve the pain; (d) administration of mercury which Smith recommends should be pushed until there are signs of salivation. If at the end of four or five days the atropin has not succeeded in dilating the pupil, the instillation of atropin should cease.

SUB-CONJUNCTIVAL INJECTIONS OF CYANIDE OF MERCURY: Some authorities report excellent results with sub-conjunctival injections of 20 drops of cyanide of mercury 1-3000, the eyes to be cocainized first.

PURULENT INFECTION OF THE WOUND: Should this occur and spread to the deeper structures of the eye, the only treatment is enucleation, or evisceration; and in my opinion, the latter is much the better operation. If enucleation is performed for panophthalmitis, there is great danger of sepsis spreading along the lymphatics and infecting the meninges, with fatal results. Many patients have lost their lives due to this operation.

If the corneal wound alone is affected, further spread may be prevented by the application of the actual cautery along the line of the incision. In some cases eyes are saved in this way, though these cases always have up-drawn pupils which can be operated on later with considerable success by Smith's method of lowering the pupil.

PROLAPSE OF IRIS: It is better not to attempt to operate on such cases for at least a week after

the cataract extraction. In the case of a very small prolapse, the actual cautery gives excellent results. If the prolapse is a large one, I prefer to give a general anesthetic as there is then no risk of the patient squeezing as in the case of a cocaineized eye.

I think chloroform anesthesia should be the routine practice in large prolapses. The iris can then be freed from the incision in which it is incarcerated. The after results in my experience have been much better after chloroform anesthesia than with cocaine. One important reason is that I have found that after one operation on the eye, the patient is often extremely intolerant of further operative interference under cocaine anesthesia.

DETACHMENT OF THE RETINA: I have seen no cases of recovery following treatment; but Smith records a case of the retina resuming its original position after energetic mercurial treatment.

DETACHMENT OF THE CHOROID: This has already been alluded to under complications occurring during the extraction of the lens, though it more often occurs immediately after the operation, within one-half to two hours.

AFTER CATARACT: This should never occur, if the intracapsular operation is successfully performed. But it occasionally follows cases in which the capsule has burst and has not been completely removed. The treatment is dealt with in detail in works dealing with the capsulotomy

operation. Of the various operative methods of dealing with after-cataract, viz., needling, couching, and extraction, I prefer the last, except in the case of very thin after-cataracts with no adhesions to the iris, in which case needling is admirably suited.

POST-OPERATIVE GLAUCOMA: This appears to be an ordinary acute glaucoma, occurring within a month of the cataract operation. Leeches, Myotis, a brisk purge, and aspirin should be used without delay, and, if no improvement is perceived, Smith recommends paracentesis of the anterior chamber every other day, (three or four times if necessary) as likely to give successful results.

DELAYED HEALING: I remember one very obstinate case of a very infirm old man, in which the incision leaked for over three weeks. Firm bandaging with instillation of protargol drops was eventually successful in curing the case.

CONTRA-INDICATIONS FOR INTRACAPSULAR EXTRACTION: There is no doubt that the intracapsular operation still fails to find favour with the majority of cataract operators and if the contra-indications were more widely known, the operation would be more widely used.

In the vast majority of cases of senile cataract it is the operation of choice. I will now briefly describe what I consider to be the chief contra-indications. Some have been already touched on under selection of cases.

(a) Glaucomatous cataract;

(b) Cataract in glaucoma;

(c) Cataract with plus tension and no other evident signs of glaucoma, though possibly this heading could be included under either (a) or (b).

In these three types of cases, capsulotomy is preferred, because of the danger of choroidal haemorrhage, as the more rapid reduction of the intra-orbital tension in removing the lens in its capsule, renders the eye more liable to detachment of the choroid, than when the tension is gradually reduced, as is the case in extracting with capsulotomy;

(d) The type of man or woman with a big "ox eye" and of a stout plethoric build. In these cases there is a greater liability to loss of vitreous;

(e) Cataract in the young adult. Here the zonula is often very difficult to rupture, and increased pressure is liable to cause loss of vitreous;

(f) All cases in which a legitimate amount of pressure does not succeed in dislocating the lens. This will mean considerably less than five per cent of cases, probably nearer two or three per cent;

(g) Congenital cataracts;

(h) Traumatic cataracts;

(i) Secondary cataracts.

CHAPTER VI

Intracapsular Operation

By J. W. WRIGHT, M. Sc., A. M., M. D.
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U. S. A.

INTRODUCTORY

The extraction of the cataractous lens, whatever the method, is doubtless one of the most intricate and delicate of surgical procedures, involving an undertaking and responsibility of scarcely less significance to the patient than that of his life. Being irreparably blind is comparable with death itself.

An eye becomes cataractous as a result of disease or trauma. This fact must not be lost sight of when a patient consults us for the restoration of vision, for the reason that complications may, to a greater or less extent, modify the visual acuity desired or anticipated. It is due to the patient that he should be apprised of whatever contingencies exist. It is taken too much

as a matter of fact that an operation is indicated whenever the lens is opaque, regardless of other conditions of the eye or the system at large. There is, doubtless, as much responsibility in knowing when to operate, as there is in the operation itself. For this reason a thorough examination of the patient should be made as to eye complications, habits, heredity and systemic conditions, including, especially, nasal and lachrymal conditions. Age is not a matter of consequence if the patient is in good health.

It is due to the patient that he should be acquainted with the fact that all operations are not successful; that a failure is possible occasionally, even when all indications appear favorable; that consequently there is a risk; and if he desires vision he must subject himself to such undertaking. Moreover, his own actions in not complying strictly with instructions may be responsible for unfavorable results.

PREPARATION OF PATIENT: The day preceding the operation the patient should have a warm bath and a mild cathartic, and upon retiring the face should be thoroughly cleaned, a few drops of a one per cent solution of atropin instilled in the eye, followed by thick gauze pads to both eyes, saturated with 1-5000 Sol. of bichloride of mercury, to remain during the night.

Before proceeding to the operation, two or three drops of a four per cent solution of cocain should be instilled into the eye every three minutes for six or seven times; and immediately

before operating the face should be thoroughly washed, particular attention being given to the lids and brows, and the conjunctival cul-de-sac thoroughly flushed with bichloride of mercury Sol. 1-5000.

PRECAUTIONS: Some observations are particularly necessary preceding this operation, especially in reference to the pupil, whether it is dilated thoroughly or not. If it has dilated well, it is not necessary to make an iridectomy, for the reason that the lens, by cautious and unrelaxing pressure, avoiding haste, is usually safely delivered, without rupture of capsule, injury to iris or loss of vitreous. On the other hand, if the pupil has not dilated thoroughly, an iridectomy or iridotomy is necessary, but a small iridectomy or an iridotomy consisting of an incision from the upper border of the pupil toward the periphery, simply dividing the sphincter pupillae, is sufficient. The circular muscle surrounding the pupil, when it is undilated, is about 3 mm. broad, so that the incision to the extreme periphery of the iris is not necessary. In making an iridectomy the same fact proves true; it being necessary only to divide the fibres of the sphincter pupillae, thus making a small iridectomy as efficient for the delivery of the lens as a large one. I very much prefer iridotomy.

It must be remembered that usually, as soon as the corneal incision is completed and the aqueous escapes, although it had been well dilated at the beginning of the operation, the pupil con-

tracts. This does not make it necessary for an iridectomy or iridotomy; the simple fact that the pupil is dilatable is sufficient.

There are occasions when the lens cannot be delivered within its capsule in safety, generally for the reason that it is so firmly attached to its supports. This condition, however, is of rare occurrence, and unfortunately cannot be definitely diagnosed before an attempt to dislocate is made. My experience has taught me about how much pressure should be made with safety, and I do not usually go beyond that point. If the lens is not readily detached from its moorings, then I do capsulotomy, because, under the circumstances, I consider it the safer method.

There is liable to be loss of vitreous in capsulotomy as well as in the intracapsular method, but there are occasions in the intracapsular where it is unavoidable to a greater or less extent; for instance when there are adhesions between the hyaloid membrane and the posterior lens-capsule, which occasionally occur, especially at the hyaloid fossa. Then there is the contingency, that the hyaloid is not ruptured, and there is that of the lens-capsule, with fragments of it adhering to the hyaloid, which interferes with vision to a greater or less extent. I must say that I have never, in my experience, had a serious loss of vitreous, but once, under this or any other condition in the intracapsular operation, although I have operated a few over one thousand cataracts.

As my method of extraction of the cataractous lens within its capsule differs considerably from most other procedures that have been devised at different times recently, a brief explanation as to its employment by me is necessary.

I began cataract operations in 1873 under the prevailing methods at that time, i. e., what is known as the flap and the combined operations, choosing the one I considered better for the particular case. Both of these methods consisted of a very extensive incision, including one-half of the corneal surface and an equally extensive flap, which resulted too frequently in imperfect coaptation, a prolapse of the iris, a drawn-up or obliterated pupil and more or less corneal opacity. To avoid such embarrassing conditions I conceived an incision much smaller, less liable to gap, and of such dimensions as to permit the ready delivery of the lens.

INSTRUMENTS: In making a cataract operation, whatever method is applied, it is customary to use the speculum and fixation forceps to steady the eye, but in my operation I seldom found it necessary to use them. I consider it much safer, if it is found necessary to separate the lids with an instrument, to use a Desmarres lid elevator, and, to steady the eye, the ordinary fixation forceps. To make the corneal incision, a Graefe knife of such form as to suit the liking of the operator is used. If it is found necessary to make an iridectomy or an iridotomy, the ordinary iris forceps and scissors are adequate. To make

pressure upon the upper segment in the process of separating the lens from the annular ligament, a small flat spatula is necessary, and counter pressure by a strabismus hook, the bend in the hook, and not its point, being applied to the lower portion of the cornea at the scleral junction. The counter pressure should be just sufficient to steady the eye whilst pressure is being made on the upper segment, as indicated. I prefer using the fingers, but all oculists' fingers are not adapted for such procedure, as are the instruments named.

PREPARATION OF INSTRUMENTS

STERILIZATION: The instruments must be well sterilized by the most thorough methods, but cutting instruments should not be boiled nor immersed in bichloride of mercury solution, as the former destroys the temper and the latter causes them to rust. I dip the blade of the knife in carbolic acid, then immerse it in absolute alcohol and when ready to operate cleanse with sterile water.

INCISION: Briefly, the incision is made entirely within the cornea, the puncture and counter-puncture being one-third down the corneal circumference, at the sclero-corneal junction, and completed at a point 2 mm. within its upper border. With this incision I discovered that pressure upon its upper segment, in addition to making the opening for the delivery of the lens much larger than in the usual methods, caused

a detachment of the lens from the annular ligament at its upper portion, when with careful pressure it is stripped out from the surrounding attachments and its delivery in capsule readily effected. Pressure thus made causes a displacement of the vitreous in such manner there that it has a tendency to seek a point of least resistance, thus forcing the lens toward the open gap caused by the incision.

After considerable experience with the technique, and realizing its importance, a description of the operation was published in the *Columbus Medical Journal*, October, 1884. Since its conception I have practiced this method with general satisfaction during my professional career. The description is as follows:

For convenience we imagine a transverse horizontal line one-third the way down from the upper edge of the cornea. A medium-sized Graefe's knife is used in making the incision. The point of entrance must be near the sclero-corneal border, but entirely within the cornea, on the imaginary line, as is shown in dotted line in Fig. 118.

The cutting edge of the knife is directed upwards and forwards, the plane of the knife making an angle of about 45 degrees with the plane of the normal iris, as is shown in Fig. 119 (The line a b represents the plane of the normal iris; c d the plane of the knife).

The back of the knife must be kept on the imaginary line and the counter-puncture made

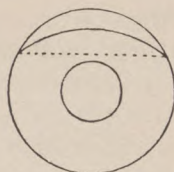


Fig. 118.

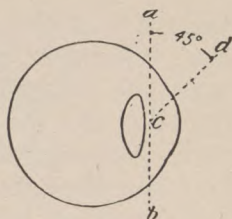


Fig. 119.

near the sclero-corneal border at a point as nearly as possible corresponding to the point of entrance. The knife is now steadily and gently pushed forward until the section is completed. The line of incision will now present the appearance of the curved line in Fig. 118.

IRIDECTOMY: The patient is now allowed to rest a moment when, if the pupil had not dilated well, the iridectomy is made. On the other hand—as has been indicated before—if the pupil had been fully dilated before the incision was made, the iridectomy is to be omitted.

CAPSULOTOMY: The next step in the operation, as usually practiced, whether an iridectomy has been made or not, has been to rupture the capsule of the lens; but I am fully satisfied that as a rule the lens is easily removed *within its capsule*, and especially so in this particular operation.

LENS DELIVERY: We will then, without rupturing the capsule, take the next step in the operation, which is to press down the upper segment of the cornea with the finger as is represented in Fig. 120. At the same time, if the

lens does not readily present itself slight pressure with a finger of the other hand may be made near the sclero-corneal border below, which is also shown in Fig. 120.

If now the lens does not readily present itself and pass out, we may rupture the capsule, and again proceed to make pressure as has been directed. The lens will now present itself and pass through the opening as represented in Fig. 121.

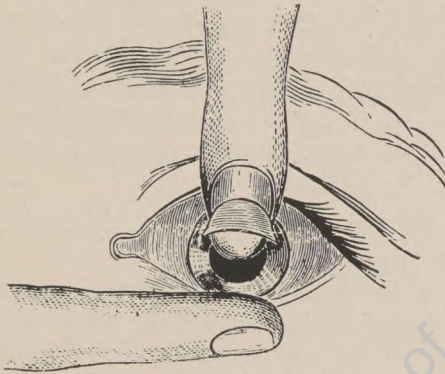


Fig. 120.

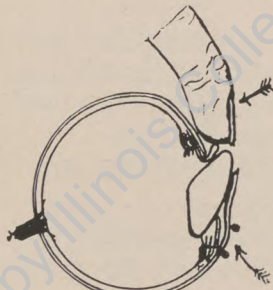


Fig. 121.

I have found this procedure much better and safer than by making the pressure with a currette or scoop, as was formerly recommended. The surgeon who once uses his fingers in the manner here described, will doubtless never thereafter resort to an instrument for the purpose of making pressure. In this way the eye can be handled with much more safety and comfort to the patient, and with greater facility to the operator.

I rarely am compelled to make pressure below the incision at the sclero-corneal border, more than to steady the eye whilst the pressure is being made on the upper segment—for the lens usually passes out as soon as the pressure above is sufficient to make the opening large enough to allow its passage.

The advantages gained by this procedure are evident.

By other methods sufficient pressure is made below the incision to make the wound gape enough to allow the lens to pass, frequently rupturing the hyaloid membrane and causing a loss of the vitreous—whereas, in this method, the opening that is made by pressing down the upper segment, as indicated, is sufficiently large—if the incision has been properly made—to allow the ready passage of the lens.

This mode of operation presents other manifest advantages:

It is the smallest possible incision that can be made, that will allow the ready passage of the lens.

The incision is made in that structure which is most likely to heal and least liable to take on dangerous complications.

The manner in which the incision is made prevents its gaping, hence there is no danger of a staphyloma of the iris.

There being no flap, and the incised surface being small, danger of suppuration of the cornea is reduced to a minimum.

Even if the wound in the cornea should leave an opaque cicatrice, it is covered by the upper lid, and does not interfere with vision in the least, but, as a rule, the cicatrice clears up perfectly, and in a short time cannot be detected with the naked eye.

On account of the pressure on the upper segment of the cornea, the corresponding portion of the iris is so pressed upon that the lens is brought immediately to its point of exit through the pupil, thus preventing its slipping up behind the iris, and bruising the ciliary body, with the resulting consequences.

Acting upon the principle of not removing any structure which can be retained without interfering with the result of the operation, in most cases we retain the entire iris, and thus secure the advantages of a central movable pupil.

The operation being almost painless, is reduced to the greatest simplicity, not requiring an anaesthetic, speculum, fixation forceps, and frequently but one instrument—a Graefe's knife.

DRESSINGS AND AFTER-CARE

TOILET: Before the dressings are applied we should be very sure, especially if a capsulotomy has been made, to remove all extraneous matter from the aqueous chambers, that no part of the iris is intruded in the corneal wound, and that the lips of the wound are perfectly adjusted. To remove lenticular matter, slight pressure on the upper segment of the cornea, sufficient to make a small gap, with counter pressure on the lower portion of the cornea, will, if carefully applied, usually be sufficient to remove whatever cortical substance remains. The lens capsule, especially if attached to the hyaloid membrane, cannot be so removed, but will require the careful use of forceps. I am opposed to removing unattached foreign substance, such as lenticular debris, from the eye with the scoop or forceps, for the reason that the slightest abrasion of the corneal endothelium, which is scarcely avoidable in such procedure, is liable to cause a lasting opacity of the cornea.

The dressing should consist of a double eye pad, composed of several layers of cotton gauze, very loosely wrung out of bichloride of mercury solution, 1-5000, over which is placed a layer or two of absorbent cotton, and held in place by a roller bandage, with enough firmness only to support the dressings. If the eye is too tightly bandaged, it will cause the wound to gap, attended usually with staphyloma of the iris.

There are other devices, such as perforated shields, placed over the eye, and held by adhesive strips, that protect it as securely as the bandage, and probably with more comfort.

I am aware that some oculists cover only the operated eye, but my experience has taught me that both eyes should be securely covered, for the reason that if one is exposed and the patient can use it, the closed one will move with its mate, when it should be quiet.

A great advantage of the moistened pads is, that in drying they become molded to the shape of the eye, and thus guard it against movement. Care must be taken that the lids are properly adjusted, and that the lashes are not turned against the eye at any point, before placing the dressings.

FIRST DRESSING: My rule, in my earlier operations, was not to make an examination of the eye until the third day after the operation, unless it was uncomfortable, but of late I allow the dressings to remain five or six days, if there is no discomfort; then, after it is dressed, if it is doing well, the patient is allowed to sit up, and the unoperated eye is given freedom. I have always given the patient considerable freedom in his habits, such as to his eating and to the use of tobacco. He should not be annoyed by visitors for one week, and his caretaker should see that his conversation is limited to his urgent needs, especially for the first three days after the operation. I have observed several operations, with promising results, prove unsuccessful from indiscretions of one form or another.

COMPLICATIONS

Contingencies liable to occur in cataract operations are: Loss of vitreous; dislocation of lens; lenticular matter, especially lens-capsule in the aqueous chambers; iris caught within wound, and finally infection.

LOSS OF VITREOUS: Loss of vitreous is the very grave objection to the intracapsular operation, and it is remarkable that it comes from those chiefly who have had no experience in the method. It is doubtful whether it is more frequent in this than in cystotomy. My impression is that it comes mostly from incautious pressure. There is a condition, however, where loss of vitreous is unavoidable in intracapsular extraction, previously mentioned, where adhesions exist between the hyaloid membrane and lens-capsule; but in my experience this condition is of rare occurrence and the loss usually very slight. When the loss is profuse there is nothing to do but to snip off any protruding vitreous and close the eye.

DISLOCATION OF LENS: Every experienced oculist knows that a dislocated lens is difficult to manage, especially when some vitreous has been lost. I have had the experience in three cases, where, after there had been detachment of the lenses with some loss of vitreous, it was found impossible at the time to remove them. In the first case, after making repeated efforts with the scoop and otherwise, and losing considerable vitreous, the eye was loosely dressed and I re-

turned in six hours to find the aqueous replaced and the lens floating in the anterior chamber, when, fortunately, it was readily removed. The patient recovered good vision.

In the second case, during the pressure act, following a cystotomy, there was a profuse gush of vitreous and dislocation of the lens. I made several ineffectual efforts to remove it. The other eye being cataractous, was at once prepared for operation, the lens being readily removed in capsule. The eyes were loosely bandaged, and both recovered promptly. In the first operation the lens became small, and floated about from one chamber to the other, exciting no inflammatory action. As the patient obtained good vision in the other eye, she declined to have the dislocated lens removed.

In the third case some vitreous was lost and the lens dislocated without delivery. The lens was in the anterior chamber, but in the attempt to remove it, it floated back into the posterior chamber, out of view. It being late in the afternoon, the eye was dressed, and the patient allowed to rest until morning, when the lens was again in the anterior chamber, but in the attempt to remove, it again passed into the posterior chamber. Further attempts to remove were abandoned and the eye was loosely dressed. For a few days the cornea remained clear and there was light preception; finally the cornea became hazy, a low grade of inflammation followed; the eye became soft and small, like in phthisis bulbi, but without suppuration.

LENTICULAR MATTER IN THE AQUEOUS CHAMBERS: In the intracapsular operation, when successfully accomplished, there is no such contingency as lenticular debris in the aqueous chambers; however in capsulotomy it is of most frequent occurrence, often because the cortical substance and lens-capsule being clear, it is not readily detected, and should the eye be dressed without its removal, the operator will be surprised, at his first dressing hereafter, to find the pupillary space filled with opaque lenticular matter. Nothing can be accomplished now, except to keep the pupil well dilated, if possible, until the extraneous matter is absorbed, if it will be. Often our greatest efforts in this direction are unsuccessful, and followed by occlusion of the pupil or adhesion of lens-capsule to the pupillary border of the iris, making a secondary operation necessary, not invariably successful, but often disappointing.

STAPHYLOMA OF IRIS: If at our first dressing of the eye succeeding the operation we find iris protruding through the lips of the wound, an attempt to replace it will be futile, and there is no preference but to snip it off as close to the cornea as possible. This procedure should be observed at each dressing as long as any portion of the iris projects from the wound. As a consequence there is liable to follow a drawn-up or obliterated pupil, more difficult of treatment than the original affection.

INFECTION: Infection is a very serious com-

plication and may unfortunately cause the loss of the eye. It may occur after the most painstaking efforts have been taken to avoid it during the operation and in the after treatment. Prompt action is required, with which all skilled oculists are conversant. My treatment has been to flush the eye with bichloride of mercury solution followed by hot water fomentations, repeated every six hours. The fomentations should be kept up, at least, one-half hour after the flushings. Argyrol, in 25 per cent solution, is highly recommended by many oculists, a few drops being instilled into the conjunctival sac every hour or so during the active stage; flushing the eye with boric acid solution frequently is also recommended. Care should be taken during the active inflammatory stage to keep the pupil well dilated.

LENSES: After the cataractous lens has been removed, in order that the patient shall obtain distinct vision, it will be necessary to have properly prescribed lenses for both distant and near vision. It has been my custom to delay permanent fitting of lenses until the eye has thoroughly recovered from the effects of the operation, which is usually three or four months; but in the meantime, in the course of a month or so, if all inflammatory action has subsided, a convex lens for distance is given the patient, which will enable him to go about with greater facility.

ASTIGMATISM: As a rule there is considerable astigmatism following the operation, which becomes gradually reduced as time passes; for this

reason after the permanent fitting, the eye should occasionally be refracted and the lenses changed, if necessary. I have knowledge of such gradual reduction in astigmatism to cover a period of six or eight years.

GENERAL CONSIDERATIONS

Since a conservative estimate indicates that about 70 per cent of capsulotomy operations are more or less complicated by the retention within the eye of lenticular debris, especially that of capsule, requiring secondary operations which are often repeated, with perfect vision seldom secured, it is but natural to seek a method that would promise more favorable results.

There are other complications in capsulotomy than those requiring needling or other secondary operation, particularly one which is rarely considered: i. e. when the capsule contracts upon itself and drops down behind the iris upon the ciliary body, where it occasionally excites a low grade of inflammatory action, often involving the iris, if not the entire uveal tract. This condition is seldom attributed to its real source. Capsular membrane is not absorbed; cortical debris often is.

GLAUCOMA: Glaucoma occasionally follows in the wake of cataract extractions, regardless of the method employed, which I believe is the result of the incision being made deep in the scleral border, thus wounding the ligamentum pectinatum and canal of Schlemm, (the channel

through which the lymph passes) which if blocked causes increased tension of the eye. For this reason, whether the incision is large or small, it should be kept well within the cornea.

The point upon which pressure is made is an important matter. It should be made upon the center of the upper segment of the cornea, near the incision, as I make it; and the counter-pressure, simply sufficient to steady the eye, at the sclera, immediately below the inferior border of the cornea. Pressure upon the surface of the cornea, especially in this method of operating, particularly when applied near its center, really contracts the opening, and impedes the delivery of the lens. Besides, this procedure frequently causes that condition known as buckling or kinking and occasionally leaves slight opaque streaks in the cornea. This is entirely avoided when the pressure is applied as directed.

The pupil as a rule dilates widely under the effects of the mydriatic without injury to the iris; for this reason the lens will, with gentle pressure, pass through the pupillary space without bruising or lacerating the pupillary border. I have knowledge of a case of dislocated lens, where, without any effort of the patient whatever, it passed from the posterior chamber to that of the anterior, and back again, in the absence of a mydriatic. I have the history of a case where the transition was readily effected at the pleasure of the patient by certain movements of his head. My effort has been to preserve every

part of an important structure of the eye when possible. A normally acting pupil is much to be preferred to an abnormal one, both in appearance and utility.

DRAWN-UP PUPIL: An additional cause of drawn-up or obliterated pupil, besides that of staphyloma of the iris, previously mentioned is, that in the usual methods of extraction, pressure is made wholly upon the cornea in such manner that the lens is pressed upon the iris, forcing it against the edge of the incision of the upper section of the cornea, thus lacerating it, the iris, causing the injured portion in the process of healing to contract and draw the pupil upward, occasionally obliterating it. For the same reason in an intracapsular operation the capsule is frequently ruptured. I am confident that pressure when applied above the incision in a great measure prevents such conditions.

COCAIN AND ITS USE: Previous to the description of my method of extraction in 1884 and for two years after, cocain was not known as a reliable local anesthetic, and my operations were made at that time without an anesthetic of any character. I often wonder how I managed my patients so well. I rarely had the least trouble, often completing the operation immediately on making the incision, before closing the lids; the only suffering complained of, being, when it was necessary to make an iridectomy. The only explanation that I can conceive, is that the desire to see was so great that they were resolved to "grin and bear it." The fact is the

cornea is not nearly so sensitive as many of us believe. A foreign body may remain embedded in the cornea an entire day, but when the eye is closed for sleep, and it comes in contact with the under surface of the lid, pain develops.

LARGE INCISION: Were I to suggest any change in my technique in the delivery of the lens within its capsule, it would be in making a larger corneal incision, making the puncture and counter-puncture slightly lower and completing it as heretofore recommended. By this means the lens may be more readily delivered.

DEXTERITY: Finally, in considering the very intricate structure of the eye, the removal of the cataractous lens cannot be other than a most delicate and tactful procedure, requiring the greatest possible dexterity. The skillful manipulation of instruments applied to such a delicate organ as that of the eye is a fine art, which is not, unfortunately, in the possession of all who would be so engaged, and those of us not having such tact, should not imagine that it reflects upon our reputation to refer our patients to such as we know are expert in their calling.

One who has not a correct knowledge of the eye structures and their functions should not attempt to experiment with this most important organ of the special senses. It requires time and deprivation and special training to prepare oneself for this delicate procedure. Colonel Henry Smith, who has had a most wonderful experience in the operation of cataract, declares that it is a specialty within a specialty.

CHAPTER VII

Intracapsular Operation

Arnold H. Knapp Method

Capsulotomy Operation, Homer Smith Method

By W. A. FISHER, M. D., F. A. C. S.

CHICAGO, ILL.

U. S. A.

DR. ARNOLD H. KNAPP'S METHOD

INTRACAPSULAR OPERATION

After the usual preparation and the instillation of one drop of atropin, under holocain anesthesia, the Koster speculum is introduced and left in place until the operation is completed, unless there is danger of an actual prolapse of vitreous.

An assistant is necessary only in the presence of complications. The section must be large and should be just short of half the corneal circumference with a conjunctival flap. After the iridectomy, the capsule forceps is introduced to a point below the center of the pupil, the branches are then allowed to separate broadly, and a knuckle of capsule is grasped. The grasp should

not be too tight, lest the capsule be torn, but sufficiently firm to exert traction on the periphery of the lens capsule. The closed branches of the forceps are gently moved from side to side, up and down, rotated, and the capsule can be seen to follow in the various directions. When the dislocation has succeeded, a part of the margin of the cataract in the capsule appears below, generally slightly to one side or the other, with the upper attachment unruptured. The forceps is then released and withdrawn. Pressure is exerted straight back on the lower part of the cornea with Smith's hook, and the cataract can be seen to turn a somersault; in other words, it "tumbles" as Smith calls it, and is delivered feet first. When the entire lens has been delivered, it will be found adherent above, where it is finally separated by a lateral stroking motion. The iris columns are then carefully replaced. The coloboma should ultimately not appear any different from that after an ordinary extraction. Knapp has had results with his operation, of which any man may well be proud.

DR. HOMER SMITH'S METHOD

CAPSULOTOMY OPERATION

This operation was originally devised for the extraction of the immature cataractous lens, but its author states that other methods should be chosen when the iris lacks the lustrous appearance of health, when the lens is amber-colored or

dark gray, or when a rigid iris forbids a dilatable pupil. Two drops of a one per cent atropin solution is instilled at fifteen minute intervals three times.

ANESTHETIC: The anesthetic used is an eight per cent solution of cocain, and one-half per cent solution of potassium chloride. These solutions are boiled and just before using are mixed in equal quantities. The use of the alkali fortifies the action of the cocain. The anesthetic is instilled four times, at four-minute intervals.

WHEN OPERATING UPON THE RIGHT EYE: When operating upon the right eye, the operator stands at the head of his patient, introduces the speculum and secures fixation by a firm grasp of the forceps over the insertion of the internal rectus. *The knife—held like a pencil, blade down*—is made to puncture the cornea at the centre of the supero-temporal quadrant; the blade is advanced to the lower margin of the dilated pupil; its edge pressed against the capsule; and, as the handle is made to describe an arc away from the operator, the blade within the eye describes a lesser arc toward the operator and in so doing divides the capsule along the vertical meridian. In executing this manoeuvre it is necessary as the cut progresses to gradually lessen the length of the shank in the eye as the space wherein it can operate decreases.

The vertical cut having been made the blade is carried over to the nasal pupillary margin on the horizontal meridian, the handle is given a

quarter turn toward the operator bringing the blade again in contact with the capsule. The arc described by the handle is now nasalward and the transverse cut made exactly as was the vertical incision. The blade now turned into its plane of entrance is withdrawn from the eye and the capsulotomy is complete.

OPERATING UPON THE LEFT EYE: When operating upon the left eye the operator stands at the left side of the patient; the knife enters in the centre of the infero-temporal quadrant and the first cut begins above, otherwise the technique is the same as that for the other eye.

After the capsulotomy the palpebral space is flushed with normal saline solution, atropin ointment is placed in the lower cul-de-sac and the patient put to bed in a quiet room for a period of about six hours.

EXTRACTION: The extraction proper which follows at the expiration of the waiting period, differs in no manner from the usual method.

IRRIGATION: The anterior chamber is irrigated with a warm sterile normal saline.

TOILET: The usual toilet is now made; atropin again instilled; both eyes bandaged; and, unless pain or discomfort ensue, the dressings are not disturbed for from two to three days.

CHAPTER VIII

INTRACAPSULAR OPERATION

W. A. FISHER, M. D., F. A. C. S.

CHICAGO, ILL.

U. S. A.

The author's operative technique represents the experience of twenty years by the capsulotomy method and nine years of operating by the intracapsular method after a season with Lt. Col. Henry Smith, at Amritsar, India, in 1913, and subsequently, a season of operating with Dr. H. T. Holland, at Shikarpur, Sind, India, January 1923.

The method to be described will permit many lenses to be delivered in the capsule, and is a slight modification of the operation as performed by Lt. Col. Henry Smith of London, England, formerly in the British Medical Service at Amritsar, India.

SELECTION OF THE PATIENT: The ophthalmic surgeon does not select his patients for cataract operations, but of course must temporarily reject those with diseased lids, lachrymal sacs,

or increased tension, until they are made as safe as can be made before operating; and he must permanently reject only those who have no perception or projection. The older the patient over forty years, the more readily will the lens be extracted. Ophthalmic surgeons as a rule do not reject patients with senile cataract, who have a prospect of even fair vision.

A GOOD RISK: A choice patient is one who is over fifty years, whose general health is good and who has lens opacities so far advanced that he is no longer able to do that which he is called upon to do with the better eye, such as reading a newspaper with the best glass that can be obtained; his lids should be free from inflammation, the lachrymal sac healthy, tension normal and the pupil acting freely in a darkened room, when a light is thrown into it from a flash light. Such a patient will usually go through the operation without complications, provided the assistant does his part by keeping the lids away from the eyeball during the operation, and especially if the operator is experienced and does not cause the patient pain. If the eye is properly cocaineized, the operation can usually be performed without pain and a good result may be expected.

SELECTION OF THE INSTRUMENTS: The instruments for a normal cataract operation, as well as any that are necessary for the complications that may occur, should be selected in the order in which they are to be used:

Medicine dropper,
Hypodermic syringe,
Scissors for cutting lashes,
Fisher's lid hook—upper lid,
Fisher's lid hook—lower lid,
Irrigator,
Fixation forceps without catch,
Smith knife,
Iris forceps,
Iris scissors,
Smith hook for expelling lens,
Smith-Fisher instrument, needle and spoon,
Blunt pointed scissors,
Smith iris replacer,
Large dressing forceps,
Capsule forceps.

CARE OF INSTRUMENTS: All instruments except the knife should be boiled with sodium bicarbonate in a tray, (Figure 122) and taken from it by the operator.

The knife should be immersed in 95 per cent carbolic acid for thirty seconds, in alcohol for two minutes, then in distilled water where it remains until used.

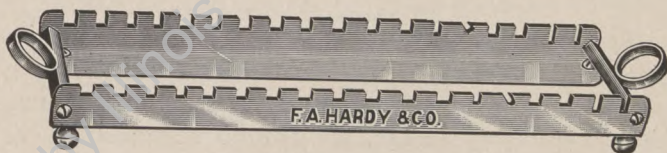


Fig. 122. Instrument Tray.

PREPARATION OF THE PATIENT: Ophthalmic operators differ regarding preparation of the patient; but all, I believe, admit that there are two stages of preparation: first, the preparation of the patient the day before the operation. Some give a laxative to all patients, but the author prefers to interfere as little as possible with the habits of the patient and gives laxatives if they require it; and if they are in the habit of taking something, give them that which they are in the habit of taking.

Secondly: It is well to have the patient in the hospital twenty-four hours in order to make urine examination, cultures from the conjunctival sac, and give them a bath; but the most important point of all is to have them talk to someone in the hospital who has been operated upon and will tell them the operation is painless. This usually relieves a nervous patient from any fear he may have.

FOCAL INFECTION: Much has been written regarding focal infection and some have emphasized the teeth as causing post-operative inflammation. Post-operative inflammation is rare in India, and I cannot conceive of any place where the teeth are neglected more, and where post-operative inflammation is less. Many patients travel long distances to have a cataract operation performed and the author believes bad teeth should not be disturbed until after the operation when the eye has become quiet; but if bad teeth are to be extracted the gums should be properly healed before operating.

THE ASSISTANTS: Good assistants are necessary in any delicate operation and in a cataract operation it is imperative that they be well trained.

TRAINING ASSISTANTS: It is a very simple matter to train an assistant, and nurses readily become competent. Two nurses can acquire dexterity by holding each other's lids with lid hooks a sufficient number of times. The author's method of teaching two nurses is to anesthetize their eyes with holocain and instruct them in the control of the lids, remembering that the assistant stands at the left side of the patient all the time, whether the right or left eye is being operated. With daily practice, the nurses soon become expert in lid control. If two nurses are taught lid control together, and upon each other, the surgeon will always have dependable assistants.

FIRST ASSISTANT: The first assistant, or the one who controls the lids with lid hooks, has the most important position.

SECOND ASSISTANT: The second assistant has a less important position than the first. Her duty is to hold, or fix, the brow of the eye being operated upon.

COMPETENCY OF ASSISTANTS: There is no specified time an assistant should devote to lid control, but it is imperative, if the best results are to be expected, that both assistants should have devoted enough time upon one another, (and under the direct supervision of the surgeon) to be considered skilful, before a cataract operation is attempted.

PREPARATION OF THE PATIENT FOR OPERATION: A few drops of a 4 per cent solution of cocain and a few drops of 1-1000 adrenalin solution is dropped into each eye twice, at five minute intervals before the patient starts for the operating room, the nurse exerting light pressure upon the tear duct for one minute, to prevent toxic effect. The patient is then taken to the operating room, placed upon the operating table, and if all has been timed and everything in readiness, four minutes will have elapsed since the last instillation of cocain. Novocain, is injected to paralyze the orbicularis (Fig. 43).

A few drops of a 4 per cent solution of cocain are again instilled into the eye to be operated, followed by a similar amount of 1-1000 adrenalin, the tear duct held for one minute, then four drops of a 2 per cent solution of cocain injected subconjunctivally where the iridectomy is to be made, the injection increasing anesthesia of the iris making the iridectomy painless.

CLEANSING THE EYE: After the third instillation of cocain and adrenalin, the injection of novocain and subconjunctival injection of cocain, the cleansing of the eye is begun and if soap enters the conjunctival sac, it does not annoy the patient. The lashes of the outer half of the upper lid are clipped, the eye and face thoroughly scrubbed with soap and bichloride of mercury one to two thousand (1-2000). This can all be done and the eye made ready for operation at the end of four minutes from the injection of cocain and novocain, or sixteen minutes

after the first application. The face, except the nose and eyes, is covered by a towel wrung from a 1-2000 bichloride of mercury solution.

Before beginning an operation, the conjunctival sac should be thoroughly cleansed and this can be done better and more expeditiously with an irrigator, Fig. 123, than by any other method. It should be suspended from the ceiling, the bottom about seven feet from the floor. One-half inch rubber tubing, with a cut-off at the distal end, and long enough to reach the eye, should be attached to the irrigator.

A warm solution of 1-2000 bichloride of mercury is used and the solution should be twenty-four hours old.



Fig. 123. Irrigator.

To prevent confusion, the technique described will be confined to the right eye, and when this is finished, the technique for the left eye will be described.

FIRST STEP OF THE OPERATION: The eye is anesthetized in preparation of patient. The first assistant stands at the left side of the patient, holding the upper lid up and away from the eyeball with the upper lid hook (Fig. 124).

The instrument is held in the right hand like a writing pen, the last two fingers resting upon the patient's nose. The forearm should be held up to give the operator room to pass his left hand around the assistant's hand.

The lower lid is held down by the same assistant with the lower lid hook (Fig. 125) held in his left hand, a second assistant or nurse holding the brow up (Fig. 126).

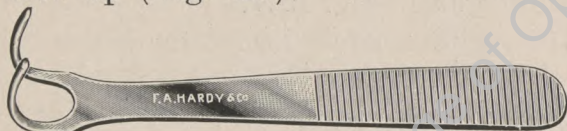


Fig. 124. Author's Upper Lid Hook.



Fig. 125. Author's Lower Lid Hook.

While the lids are being held in this manner, the eye is flushed with three ounces of warm 1-2000 bichloride solution from the irrigator. Any of the solution left in the conjunctival sac

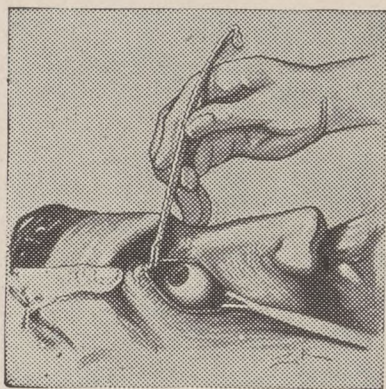


Fig. 126. Eyelids held in position for flushing.

must be removed which can be done easily, with a sterile medicine dropper.

SECOND STEP IN THE OPERATION (Right eye): The upper lid hook is lowered and nearly rests upon the globe (Fig. 126).

The operator stands behind the patient's head and fixes the eye at the sclerocorneal junction with fixation forceps (Fig. 127) which has been passed from the operator's right to his left hand after his left hand has been passed under the assistant's right arm. The operation is finished without removing the lid retractors, but the assistants should not change their positions until the operation is finished, when the lids should be



Fig. 127. Fixation forceps without catch.

closed and the retractors slipped out from beneath the closed lids, the upper one first.

INCISION: (Fig. 128). The first and second assistants are in position as described in Fig. 126. The lids are held apart as they would be if a speculum was being used, the upper lid hook holding the upper lid far enough from the eyeball to keep pressure from it.

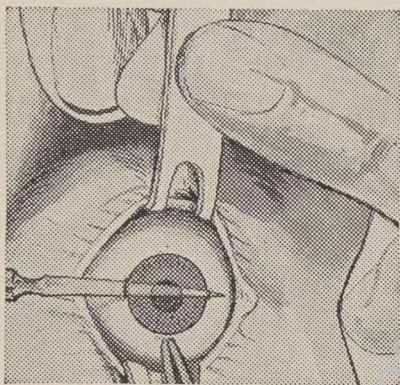


Fig. 128. Lids being held by lid hooks for first part of the Incision.

The operator grasps the eye with fixation forceps at the sclerocorneal junction, raises the eyeball up, and holds the knife (Fig. 129) as he would a pen. The blade of the knife and the plane of the iris form an angle of 15 degrees. The puncture is made as deeply through the limbus as is commensurate with safety; the knife passes across the anterior chamber with its back in the center of the pupil; and the counter punc-

ture is made as deeply as possible, keeping in front of the iris.

The handle of the knife is slightly depressed as soon as the point is engaged in the counter-puncture in order to cut as little conjunctiva as possible. In this manner, one-half of the cornea is cut, the puncture and counter puncture being as deep as possible and the incision 180 degrees. The incision is finished in the cornea about two millimeters from the sclerocorneal junction, and if possible, with one upward and forward sweep of the knife.

If the incision cannot be finished with one sweep, a sawing movement is made, though one forward sweep is always desirable because it leaves two smooth edges, while a to-and-fro movement is more likely to leave ragged ones.

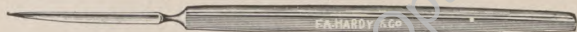


Fig. 129. Smith's Modification of Wilson Knife.
The back of the knife is straight, the blade very thin at point.
The author considers it the ideal knife.

Fig. 130 (a continuation of Fig. 128). If the handle of the knife is depressed when the counter puncture is being made, and the knife is kept moving forward and up, always being held lightly between the fingers, the incision can usually be finished with one upward and forward sweep of the knife.

THE IRIDECTOMY: The closed iris forceps is inserted into the anterior chamber, opened, and

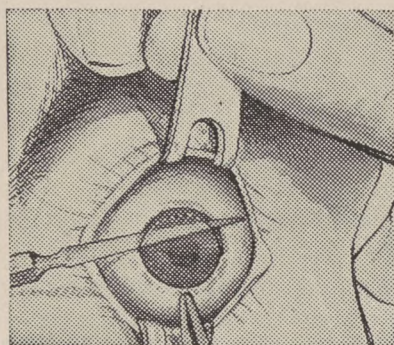


Fig. 130. Finishing the incision.

the iris grasped near the upper edge of the pupil, pulled out and a small piece cut, making a small iridectomy which prevents iris prolapse quite as effectively as a large iridectomy. A large iridectomy does not materially aid in lens delivery. The iridectomy is usually painless, if cocain and novocain are injected as heretofore described.

LENS DELIVERY: There are two distinct methods of lens delivery, the upright and the tumbler.

THE UPRIGHT: The upright is usually selected in immature cataracts and the technique is as follows:

FIRST STEP IN LENS DELIVERY: Fig. 131. The first and second assistants are in position as

described in Fig. 126. The operator stands at the right side of the patient irrespective of which eye is being operated.

This is important because he can see the whole field of operation by looking up under the lid even if the patient looks up. The patient is not requested to look down as in the old operation, and if not spoken to he will naturally look straight ahead or up, which is the safest position for lens delivery.

The operator holds the Smith hook (Fig. 132) in his right hand as he would a pen; and in his left hand, which has been passed around the first assistant's hand, he holds the Smith-Fisher instrument (Fig. 133) one-half inch above the eyeball in position to be used if the lens refuses to be delivered.

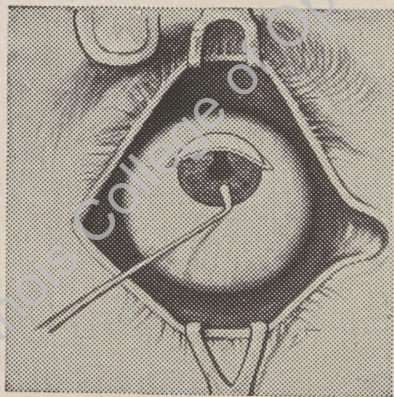


Fig. 13r. First position in lens delivery.



Fig. 132. Smith's Hook.

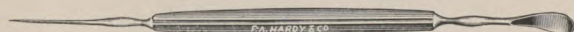


Fig. 133. Smith Spoon and Author's Needle.

The operator now places the Smith hook flat upon the cornea, the point being half way between the lower edge of the normal pupil and the sclerocorneal junction. Pressure is then made steadily backward, toward the optic nerve. When the zonula breaks above, the lens will be seen presenting in the corneal wound (Fig. 131).

Pressure is continued slowly toward the optic nerve, and if a good incision has been made and the lens is not too large, the presentation will be unobstructed. If the left eye is being operated upon, the hook is placed on the cornea, the handle being over the nose.

SECOND STEP IN LENS DELIVERY: Fig. 134. (A continuation of Fig. 131). The lens is passing the equator and very gentle but continuous pressure is kept up with the hook, which is held lightly in the fingers, and as soon as the lens has passed the equator, it will remain in this position where it is hooked out as Fig. 135.

The lens should not be touched with the point of the hook or pushed out of the wound with it, on account of the danger of rupturing the capsule.

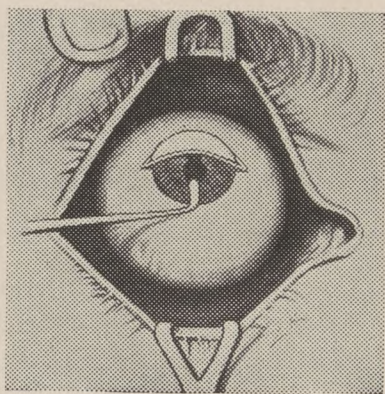


Fig. 134. Second position in lens delivery.
Lid Hooks in position.

THIRD STEP IN LENS DELIVERY: Fig. 135. (A continuation of Fig. 134). If all has gone well and the lens is hanging in the wound, the operator slowly and deliberately passes the hook around it, keeping the point of the hook upward to prevent rupture of the capsule, and at the same time keeping the point of the hook from entering the corneal wound.

The lens is delivered by gently pulling the hook across the corneal wound under it. The extraction is now completed and the next step is the toilet.

THE TOILET (Fig. 136): If the operation has progressed to this stage without accident, the only things remaining are the toilet and the bandage. The toilet is an important part of a cataract operation and the iris replacer (Fig. 137) should be deliberately used.

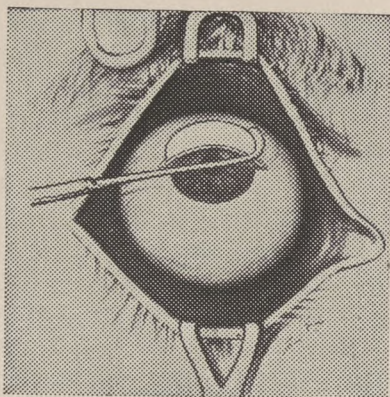


Fig. 135. Third position in lens delivery.
Lid Hooks in position.

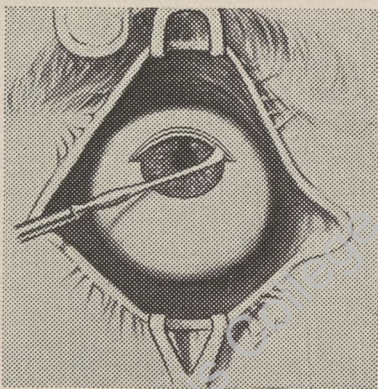


Fig. 136. Toilet. Patient looking up and
spatula introduced from below.

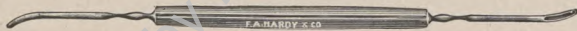


Fig. 137. Smith's Iris Replacer.

It is not only unnecessary but even dangerous to have the patient look down during any part of a cataract operation, and the toilet of the iris is facilitated by having the patient look up; if the patient looks down, the iris has a tendency to be crowded into the wound, which is to be avoided.

While the patient is looking up, the iris replacer is passed into the angles of the wound, replacing the iris if caught. Flushing is unnecessary at this time since the field of operation was made clean before the operation was begun, as well as the hands of the operator and the instruments.

The use of the lower lid hook is a new procedure, as far as I know, and original with me. Likewise the employment of the needle to assist in the delivery of the lens when there is threatening or actual loss of vitreous, has never been suggested before. This will be described more fully in a later chapter.

THE BANDAGE: The bandage is an important part of the technique, and the greatest care should be taken against any kind of pressure. I prefer sixteen thicknesses of gauze, long enough to cover both eyes, with a notch for the nose, to keep the bandage from slipping away from the eye.

The closed lids are covered with carefully prepared yellow oxide of mercury ointment, one grain to the drachm, squeezed out of a tube. The gauze is then laid upon the eyes and fastened to the brow with two small adhesive strips to pre-

vent slipping downward. A starch bandage is then applied to both eyes and the patient put to bed.

A cross section (Fig. 138) will serve to make plain the pressure in upright delivery. The pressure is made continuously towards the optic nerve, pushing the lower edge of the lens backward, tipping the upper edge forward, breaking the zonula above and causing the lens to advance and engage in the wound, as in Fig. 131. When the lens has advanced as in Fig. 134, continuous pressure is changed to an upward direction, as in Fig. 139, the hook following the advancing lens, tucking the cornea under the lens.

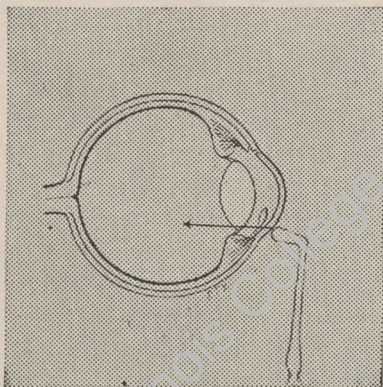


Fig. 138. Cross section showing position of pressure in upright delivery. (Vail).

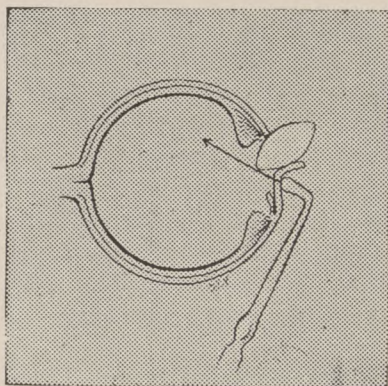


Fig. 139. Cross section showing second pressure in upright delivery. (Vail).

TUMBLERS: Fig. 140. *The technique of lens delivery in a tumbler is selected in a ripe or over-ripe cataract. The pressure is not made toward the optic nerve as in the upright, causing the zonula to rupture above and come out top first, but the point of the hook is caught on the ciliary ridge and the pressure is made down toward the patient's feet, (Fig. 140) causing the zonula to rupture below.*

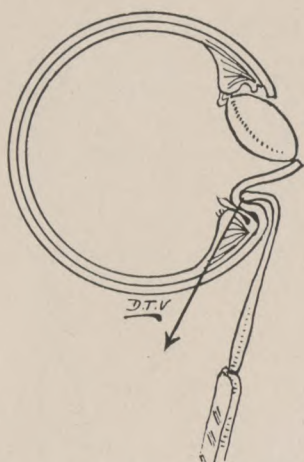


Fig. 140. Cross section showing point of hook caught on ciliary ridge for tumbler, with pressure downward. (Vail).

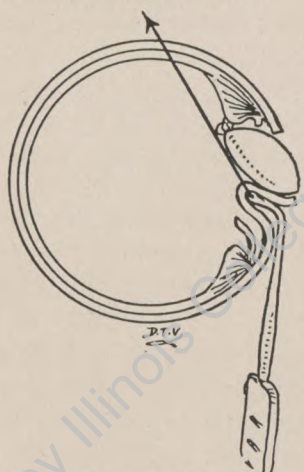


Figure 140a.

The second step in a tumbler. Downward traction has been removed, and the cornea is being tucked in behind the lens.

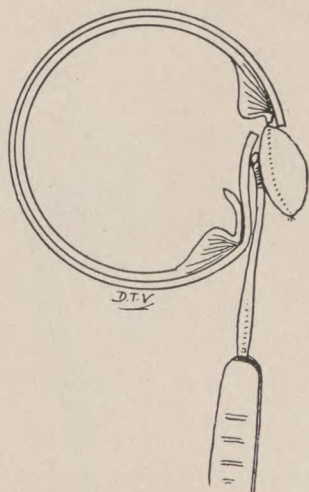


Figure 140b.

The third step in a tumbler. The lens is ready for final delivery, as in Fig. 135.

When the zonula ruptures below the lens begins to tumble or turn over, the wound gaping widely, the pressure of the hook downwards is continuous until the lens is seen to tumble or turn over, when the pressure is changed and the hook follows up behind the advancing lens, tucking the cornea in behind the lens (Fig. 140a, 140b).

If the capsule ruptures in lens delivery in the upright method in which the pressure is made toward the optic nerve, tipping the upper edge of the lens forward, rupturing the zonula above, the capsule would naturally slip back into the eye.

Some operators, including Smith, attempt removal with capsule forceps, while others prefer letting the capsule remain, and needling if necessary. If the capsule ruptures in the tumbler method, when the pressure is not made backward toward the optic nerve, but downward toward the patient's feet (Fig. 140) the zonula breaking below the capsule would hang in the wound where it could easily be removed with large dressing forceps (Fig. 141).

Fig. 142. The assistant is pulling the upper lid down and away from the eye, this being done if the patient is nervous or there is impending or actual loss of vitreous, when the position of the hook is changed to pull the lid down, which takes all pressure away from the globe.

The two prongs of the hook are caught behind the cartilage, there being then no danger of the instrument slipping out, but the lids must not be pulled down enough to cause the patient pain. This part of the technique is easily mastered by practice on any eye that is anesthetized, and it is very important that the assistant understands when to do this and how to do it.

OPERATION UPON THE LEFT EYE: The positions of the first and second assistants are the same as when operating upon the right eye, except that the first assistant rests his last two fingers upon the patient's temple instead of the nose.

The surgeon stands at the left side of the patient and makes the incision with his right hand.



Fig. 141. Large Dissecting Forceps.

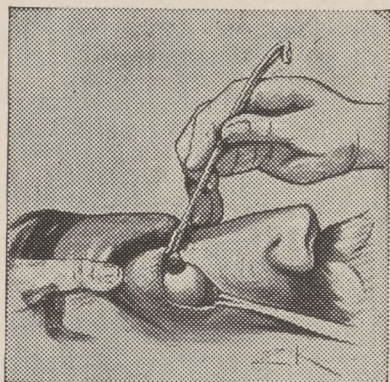


Fig. 142. Loss of vitreous has occurred, or patient is unruly. Lid hooks are in position and the upper lid is being pulled down and away from the eyeball.

He then resumes his position upon the right side of the patient, makes the iridectomy, and delivers the lens by laying the handle of the hook across the patient's nose.

COMPLICATIONS AT THE TIME OF OPERATION: The technique of a cataract operation would not be complete without describing the complications.

Operators of large experience do not see complications as often as those operating less frequently; but the necessity of dealing with complications is imperative, the most serious of which is loss of vitreous.

LOSS OF VITREOUS AFTER LENS DELIVERY:
When vitreous loss occurs after the lens has been delivered, the complication is not considered so great as when occurring before lens delivery. The lids are held away from the eye ball, and the operator deliberately cuts off any protruding vitreous (Fig. 143). The closed lids are covered with 2 per cent yellow oxide of mercury and bandage applied.

VITREOUS LOSS PRECEDING LENS DELIVERY:
Loss of vitreous preceding lens delivery is a serious complication because the lens cannot then be delivered by pressure.

The operator deliberately and without haste, applies a little pressure on the cornea, as in Fig. 131, and at the same time introduces the needle into the lens if it presents in the corneal wound. An operator without experience is cautioned not

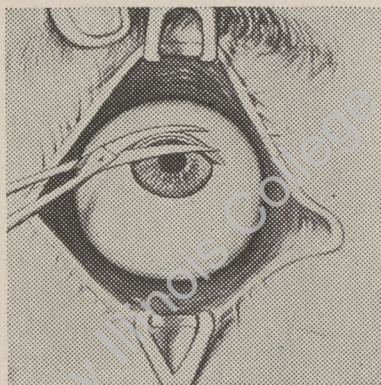


Fig. 143. Cutting off vitreous.

to pick at the lens with the needle, but to stick the needle well into the lens, then make more pressure with the hook and lift the lens out. If the lens drops back into the eye and cannot be made to present in the wound by pressure, the Smith spoon should be used (See Fig. 144).

FENESTRATED LOUPE: This instrument has been in use so long that some ophthalmic surgeons seem to think it should remain as one of the good instruments. The author can see no use for it, since Smith's spatula is less dangerous.

SMITH METHOD: Smith's method of removing a lens when a loss of vitreous has preceded lens delivery is not a difficult procedure for those who have experience in its use and the author believes that any operator who can successfully use a loupe can use the Smith method successfully.

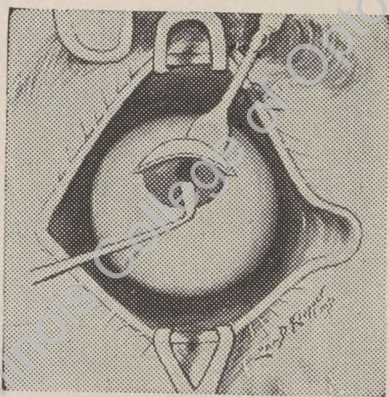


Fig. 144. Smith's Method of Removing the Lens When a Loss of Vitreous has Preceded Lens Delivery. Lid Hooks are in position.

SMITH'S TECHNIQUE: The first and second assistants are in position as in Figure 126. Some vitreous has escaped before the lens has been delivered, pressure of the hook is removed, and the Smith spatula is deliberately passed behind the lens.

When the spatula is well in place, the pressure is again made by the hook just below the spatula; the pressure in this manner is not upon the vitreous, but upon the spatula, and the position of the spatula is not changed until the lens has been delivered.

The only part in the operation that the spatula performs, is to be pressed upon and protect the vitreous, acting as an inclined plane over which the lens slides; if any of the vitreous remains in the wound after the spatula delivery, it should be cut off with scissors. This technique is not easy to master, but satisfactory practice can be obtained by practicing upon kitten's eyes in a mask (See Chapter X).

The author's needle can be used when necessary to make the Smith operation possible to operators not having the opportunity of Smith's personal teaching, and at the same time to rob it of the danger of loss of vitreous.

FISHER'S NEEDLE DELIVERY: (Fig. 145). If the lens presents in the corneal wound, but will not come forward without what is considered by the operator as unsafe pressure, the needle is stuck into the lens, after which more pressure is made by the hook until the lens passes the equator and the operation may be finished as in Fig. 135.

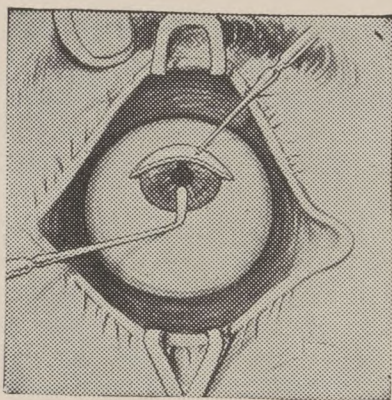


Fig. 145. Fisher's Needle: Fisher's method of removing the lens when it refuses to be born, or when a slight loss of vitreous has preceded lens delivery.

It is quite reasonable to infer that the more often the needle is used, the more capsules will be ruptured, but many hard lenses may be removed in their capsule by the aid of the needle. To offset the complications of burst capsules, the author claims less vitreous loss.

No more serious complication usually occurs than rupture of the capsule, but the more expert the operator, the less often will he use the needle.

RUPTURED CAPSULE: Fig. 146. The first and second assistants are in position as in Fig. 126. If the capsule has ruptured and lens matter or capsule is incarcerated in the corneal wound, a large dissecting forceps (Fig. 141) as used by Colonel Smith, is one of the best instruments to remove it.

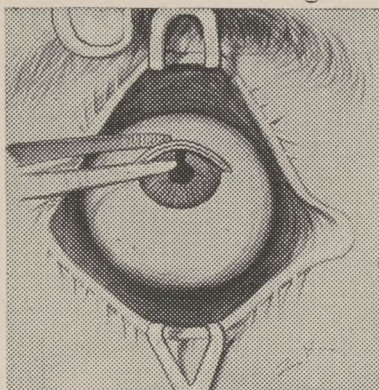


Fig. 146. Removing cortical or capsule with large dressing forceps. Lid hooks are in position.

The forceps are not passed into the eye, but over the lips of the wound with a little pressure; the soft material and any capsule that can be caught are made to pass out of the eye, grasped by the forceps, and removed.

When the capsule bursts and the zonula is broken below (Tumbler Fig. 140), it can be removed with large dressing forceps (Fig. 146).

SMALL INCISION: If the incision is too small to allow lens delivery with safe pressure, it can be enlarged by cutting each side of the wound with blunt pointed scissors.

CHOROIDAL HEMORRHAGE: This complication is very infrequent, but when it occurs vision is lost and it is often necessary to remove the eye.

SPECULUM: By discarding all kinds of specula and holding the lids with lid hooks, most of the accidents occurring at the time of operation can be avoided.

If an operator masters the hooks for controlling the lids, he can readily teach an assistant, and both operator and assistant be well equipped before attempting a cataract operation.

COMPLICATIONS AFTER THE OPERATION: The complications occurring during the healing process will be taken up under "After Treatment." (Page 228).

AMBIDEXTERITY: A surgeon who has good use of both hands is fortunate, but it is quite unnecessary to use the knife with the left hand unless the operator is left-handed. It is however, necessary for him to pick up the iris with one hand and cut it with the other, unless he entrusts the cutting to an assistant.

If an operator is right-handed, his right hand will usually be the more skillful, no matter how much he trains the left. He can make the incision on the right eye with his right hand when he is standing behind the patient, and when operating upon the left eye stand at the patient's left side, fix the eye with his left hand, make the incision with the right hand and cut upward. If he is left-handed reverse the above.

The author tried faithfully for twenty years to become ambidextrous, until he was convinced by Col. Smith that acquired ambidexterity was impossible.

HOW CAN PROFICIENCY BE OBTAINED: When a physician decides to enter the field of Ophthalmology, he must equip himself by reading and post-graduate work, assisting an Ophthalmologist, or serving as an interne in some Ophthalmic hospital; but will soon learn that he will have very little practical work in cataract operations. He will consider himself fortunate indeed if he is permitted to operate upon a half dozen eyes.

It is very important therefore, that he perfect himself in a technique that will produce the best results, and human eyes are too precious to be used for this purpose. Text books describe the classical operation, but one cannot learn to perform successful cataract operations by reading. He must learn by operating.

To an operator inexperienced in any method, the danger of losing an eye is very great, and some teachers suggest that a beginner should operate one hundred times by the old method before attempting the removal of a lens within its capsule.

The author emphatically objects to this method of teaching, because he believes the technique described in this chapter can be mastered more readily, with fewer losses of eyes, than would occur by trying to master the old technique so carefully described in text books.

INCISION: A good incision must be made in order to extract a lens successfully; and when a good incision is made the lens can usually be removed successfully by any method. A beginner

in ophthalmic surgery can learn to control the lids and become quite expert upon human eyes that are anesthetized, provided enough time is devoted to it, and this should be mastered before thinking of operating.

Any operator will have an occasional loss of vitreous preceding lens delivery whichever method is selected; and if he must remove the lens from the vitreous by methods other than Smith's or the author's, he will sacrifice many eyes.

Loss of vitreous preceding the delivery of the lens is considered a very serious complication, but one may become quite expert in removing the lens by the Smith method upon kittens' eyes as described in Fig. 144, and by the author's method, Fig. 145. To become proficient in this technique, requires practice, and this can be obtained upon kittens' eyes in a mask, but cannot be mastered upon human eyes without a tremendous loss.

PROFICIENCY: Proficiency in any delicate operation is often difficult to obtain, and it is practically impossible to become competent to remove a lens from a human eye by reading or witnessing operations. The technique herein described may seem awkward at first, but a little practice in controlling the lids of human beings and operations upon kittens' eyes, will be of great aid.

AFTER TREATMENT: After the lids have been anointed, a light bandage, 16 layers of gauze, is

applied without pressure, the patient put to bed, told he may lie on either side or on his back, and remain fairly quiet for twenty-four hours. At the end of that time he may be up if desired, or in bed if he prefers.

A slightly uncomfortable feeling may be experienced for a few hours after the operation, but is of no serious consequence. If a starch bandage is used, it should be cut in front of each ear, after it has become hardened, and the cut ends sewed together. If too tight, it should be loosened and if too loose, may be tightened.

FIRST DRESSING: The author usually removes the bandage the day after the operation, inspects the lids, but does not open the lids of the operated eye unless they are swollen. The operated eye only, is rebandaged.

SECOND DRESSING: The eye is inspected and rebandaged at the end of the fourth day, but the lids are not opened unless swollen.

THIRD DRESSING: The eye is inspected and rebandaged, at the end of the seventh day, but the lids are not opened unless swollen.

FOURTH DRESSING: The operated eyeball is inspected at the end of the ninth day and daily thereafter, keeping it protected by a gauze patch as long as the light is irritating.

POST-OPERATIVE INFLAMMATION: If the patient complains of pain in the eye before the first inspection is made, the bandage is removed, a leech applied to the temple, the bandage re-applied, and the patient given an enema; it is not often necessary to do more.

Post-operative inflammation is rare after this method because the lens is usually removed in the capsule, and if the capsule is ruptured little if any cortical is left.

If infection follows a cataract operation, the eye is usually lost. The author believes more infections will occur by too frequent dressings than can be cured by too much treatment.

FIRST INSPECTION: When the eye is inspected the ninth day after the operation, the operator places the patient with his back to a window and if he can count fingers at a distance of three or more feet, he can assure the patient of a good result. If the anterior chamber is not full, or if there is a prolapse of the iris, the eye is again bandaged for three days. The author believes in giving nature a chance in the healing process, and does not see any advantage in cutting a prolapsed iris until two weeks or more after the operation, and even not then, unless large.

PROLAPSED IRIS: If the iris is prolapsed, it can be more safely cut after fourteen or more days than earlier. If cut too soon, the corneal wound may be opened, inviting serious complications. No attempt should be made to pull the iris out, but simply cut off with scissors without holding the eye with fixation forceps.

TEMPORARY INSANITY: It is comforting to the patient to have some intimate friend or relative sleep in the same room with him. If he dreams of unpleasant things and is spoken to by a friend, he may recognize his voice and awake,

while a strange voice might frighten him and increase his fear.

The author believes that if a relative or friend be present the first week, it will do more toward quieting such patients, than opening the eye and giving all the drugs that have been recommended. If delirium however persists, the bandage may be removed and sedatives administered.

TESTING VISION: It is sufficient to hold a pin-hole disc in front of an operated eye and a plus ten (+10.00) in front of it as soon as the patient can hold the lids open without discomfort. The vision in this manner is recorded daily; the test is quickly made and permits the patient to note his progress. If at the end of two weeks his vision is 20/50 or better, he will note a daily improvement.

TIME IN HOSPITAL: The author usually keeps his patients in the hospital about three weeks, but many who do not live at a great distance are dismissed earlier.

GLASSES AFTER A CATARACT OPERATION: The patient is tested for glasses to complete the hospital record before being dismissed, but glasses are not given until about six weeks after the operation.

When patients live out of town, they are requested to go to their nearest oculist for glasses, six weeks after the operation. The author requests a final report of vision from the oculist to complete the case records.

BIFOCAL GLASSES: Many patients will feel grateful for bifocal glasses, but good fitting frames are essential.

CHAPTER IX

A METHOD OF ACQUIRING TECHNIQUE

Capsulotomy or Intracapsular Method

W. A. FISHER, M. D., F. A. C. S.

CHICAGO, ILL.

U. S. A.

A cataract operation is considered one of the most delicate of surgical procedures, and requires the highest degree of skill to insure good results, which can only be acquired by operating many times.

It is generally admitted that ophthalmic surgeons who have confidence in themselves have acquired it in only one way, viz: by operating; but years must be spent and many eyes sacrificed in acquiring proficiency, because of the lack of opportunity to operate. When confidence is obtained in this manner, the surgeon is loathe to change his technique, or make any radical alterations in it.

The technique to be described is applicable to any method of removing a lens, whether in or out of capsule. Experienced operators can readily adopt it, reduce complications and expect better visual results; while to the inexperienced it offers a practical method of obtaining technique in every step of the operation, whichever method is selected.

Living human eyes are too precious to sacrifice in obtaining operative skill, and those of the cadaver are not suitable. The eyes of various animals have been tried, those of the pig usually being selected because they are easily obtained in quantity; but it is quite impossible to acquire a good working technique with them. The structures of the pig's eyes are out of proportion to those of human eyes.

KITTENS' EYES: The eye of a kitten 6 weeks old is selected because its cornea is about 11 mm. in diameter, which is the same as an ordinary human adult's, and especially because it is a simple matter to demonstrate the operation, and place it within easy reach of anyone who is ambitious. Enough kittens may be sacrificed to make the operator quite proficient in the different steps of the operation, and this of itself will spell success.

THE INCISION: If kittens' eyes are operated upon in sufficient quantities, one may be able to make a good incision at his first operation on the human eye, because the cornea is practically the same as that of the human eye.

THE IRIDECTOMY: The same may be said of the iridectomy, because the iris of the kitten is quite delicate and very like the human iris. The widely dilated pupil in the eye of a dead kitten makes the iridectomy more difficult than in the living human eye, but this objection can be partially obviated by dropping into the eye, four times, every four minutes, 2 or 3 drops of physostigmin (eserin salicylate), 1 grain to the ounce, before killing the kitten.

THE LENS DELIVERY: Skill can be acquired in lens delivery because of the similarity of the kitten's eye to that of the human eye.

THE TOILET: This is a delicate and very important part of cataract operation by any method, but in this, as in the incision, iridectomy, and lens delivery, quite a good technique can be acquired by operating on kittens' eyes.

THE SPOON AND NEEDLE: The spoon delivery as devised by Colonel Smith, formerly of Amritsar, India, now of London, and the needle of the author can be mastered on the kitten's eye more readily than on the human eye, because responsibility is eliminated, and the technique can be repeated until one is confident of himself.

The accompanying illustrations of six weeks old kittens' eyes are from drawings, natural in size, and represent the different steps in a cataract operation on the kitten's eye, and also on the human eye.

The kitten should be dusted with powdered naphthalene to dispose of any vermin present,

and then given hypodermically one-half grain of strychnin sulphate intra-pleurally. The eye is then enucleated and a thread passed through the sclera and optic nerve preparatory to putting in a mask for operating.

In Fig. 147, the eye has been removed and a thread passed through the sclera and optic nerve preparatory to fastening in the mask.

Fig. 148. The eye is in the mask ready for operation. The screw in the bottom can be used for tightening the eye in the mask, and for producing the proper tension.



Fig. 147. Eye of kitten 6 weeks old,
natural size.

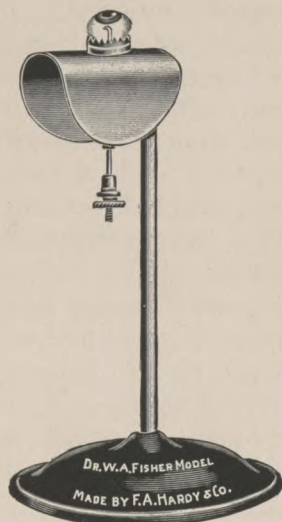


Fig. 148. Author's mask.

THE INCISION: Kitten's Eye. (Fig. 149). The knife is held loosely between the fingers in the same manner as one would hold a pen. The blade is not placed flat, but at an angle of 15 degrees from the iris. In this position the puncture is made as far back from the sclerocorneal junction as can be done with safety, always, of course, keeping it in front of the iris.

The knife in this position is passed across through the anterior chamber, and the counter puncture is made deep like the puncture. In this manner, the opening for the exit of the lens will be as large as it is possible to make it.

THE INCISION: Human Eye. (See Fig. 128). The assistant is standing in the correct position, at the left side of the patient, holding the upper lid up with the author's double hook in his right hand, and the lower lid down with the author's lower lid hook in his left hand. A second assistant or nurse is holding up the brow with the thumb. In this position the first part of the incision is made.

The knife is passed across and through the anterior chamber, deep puncture and counter puncture is made in the human eye as illustrated in the kitten's eye (Fig. 149).

The incision is always made with the right hand if the operator is right-handed, and with the left if he is left-handed.

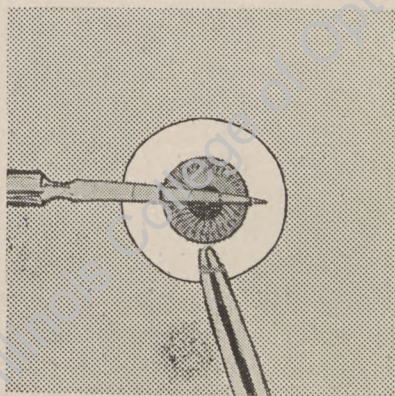


Fig. 149. The incision. Puncture and counter puncture—kitten's eye.

If right-handed, the operator stands at the head of the patient, looking toward his feet when making the incision on the right eye; and when operating on the left eye he stands at the left side of the patient and cuts up. If left-handed the position is reversed.

The assistant always stands at the left side of the patient when operating on either eye, and the right-handed operator at the right side of the patient at all times except when the incision is being made on the left eye.

KITTEN'S EYE: (Fig. 150). The knife in the second position, (a continuation of Fig. 149) is made to finish the incision by the operator depressing the handle and pushing the blade forward and up, making the incision with but one forward and upward cut.

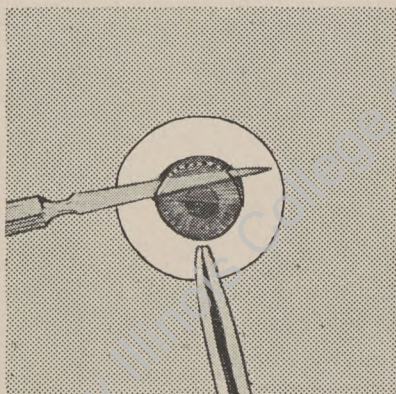


Fig. 150. Finishing the incision, kitten's eye.

HUMAN EYE: (See Fig. 130). The knife in the second position, (a continuation of Fig. 128) is made to finish the section in the same manner in the human eye, as described in the kitten's eye (Fig. 150).

IRIDECTOMY: Kitten's Eye. (Fig. 151). The iridectomy on the kitten's eye is quite like that on the human eye. The iris forceps has been passed into the anterior chamber closed, then opened, the iris is grasped at the pupillary edge and pulled out ready to be cut off with the scissors, when a very small piece of iris is removed.

CAPSULOTOME AND CAPSULE FORCEPS: The next step in the capsulotomy operation would be the use of the capsulotome or capsule forceps, but will be omitted at this time and the operation for lens extraction in capsule will be described.

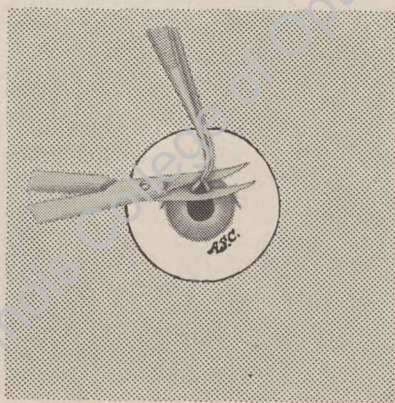


Fig. 151. Iridectomy. Kitten's eye.

BREAKING THE ZONULA: Kitten's Eye. (Fig. 152). The intracapsular operation is not suitable for young subjects because too much pressure would be required to break the zonula. As the kitten is young, the spoon is passed through the zonula, to break it, in order that lens delivery may be practiced in a more nearly normal manner.



Fig. 152. Breaking the Zonula, kitten's eye.

LENS DELIVERY: Kitten's Eye. (Fig. 153). Intracapsular Method: Beginning pressure, immature cataract: Pressure is being made with the hook on the lower third of the cornea toward the optic nerve, the same as would be made when operating on immature human cataracts. The lens is advancing in the corneal wound.

LENS DELIVERY: Human Eye (Fig. 131). Intracapsular Method: The lens is advancing in the corneal wound in the same manner as described in the kitten's eye (Fig. 153).

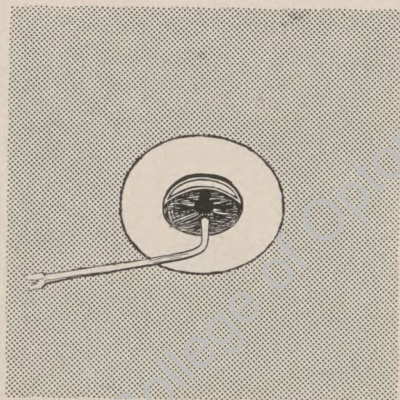


Fig. 153. Lens delivery, first position, kitten's eye.

LENS DELIVERY: Kitten's Eye. (Fig. 154, a continuation of Fig. 153). Pressure has been continuous toward the optic nerve, and the lens is progressing toward delivery.

LENS DELIVERY: Human Eye (Fig. 134). Immature Cataract (a continuation of Fig. 131). With the human eye quite the same technic is observed as with the eye of the kitten, as illustrated in Fig. 154.

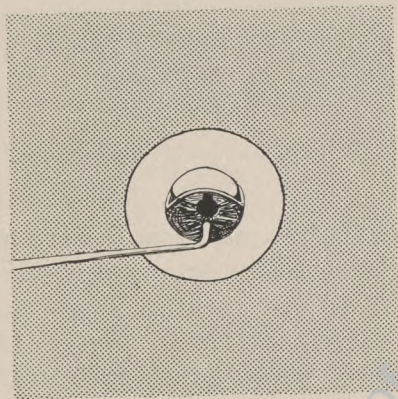


Fig. 154. Lens delivery, second position, kitten's eye.

LENS DELIVERY: Human Eye (Fig. 135, a continuation of Fig. 134). The lens is being delivered in the human eye in the same manner and with exactly the same technique as in the operation on the eye of the kitten (Fig. 153, 154, 155).

TOILET IN THE KITTEN'S EYE: (Fig. 156). The spatula (Fig. 137), is passed into the corneal

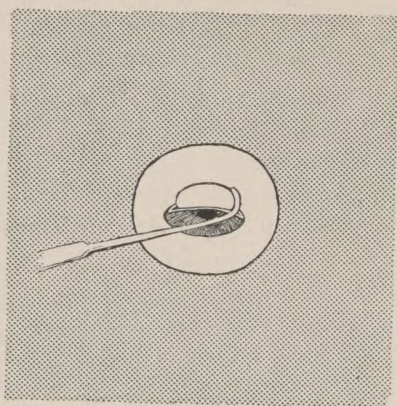


Fig. 155. Last position, Lens Delivery, kitten's eye.

wound from below, and this iris is pushed away from the angles in the same manner as would be done on the human eye (Fig. 136).

TOILET IN THE HUMAN EYE: (Fig. 136). The spatula is passed into the corneal wound from below while the patient is looking up, which is a safer position than when looking down, and the iris is pushed away from the angles of the corneal wound in the same manner as is done in the operation on the eye of the kitten (Fig. 156).

FINISHED OPERATION: The operation in an uncomplicated intracapsular cataract is now finished. The technique, which is delicate, can be acquired only by practice; but removing a lens by any method requires a great amount of practice.

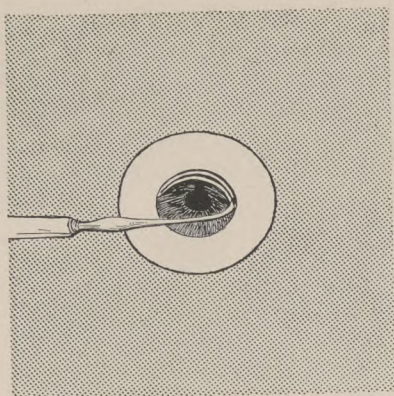


Fig. 156. Toilet, kitten's eye.

The technique of a cataract operation can be obtained in a more satisfactory manner by operating on kittens' eyes than on the living human eye, because of the absence of responsibility.

COMPLICATIONS: If the Smith spoon delivery and the author's needle were omitted, the technique of operating for cataract would not be complete, because they are indispensable when complications occur.

SMITH'S SPOON DELIVERY: Kitten's Eye. (Fig. 157). In the Smith technique, pressure is made on the cornea with the hook held in the right hand as illustrated in Figures 153, 131, 154, 134, 155 and 135, while the spoon (Fig. 133) is held in the left hand ready to be used when vitreous loss is imminent, or has actually occurred, at which time and without delay, the

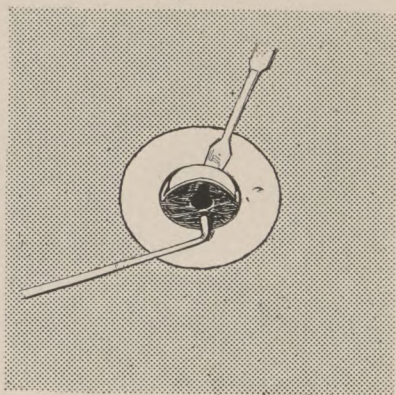


Fig. 157. Smith spoon delivery, kitten's eye.

pressure being made with the hook is relaxed; the spoon is then passed down behind the lens, and pressure made on the cornea with the hook at the lower edge of the lens, which is now between the hook and the spoon. The lens is made to pass up the spoon and out without removing the latter.

The object of putting the spoon behind the lens is not to lift the lens out, but to be pressed on.

SMITH SPOON DELIVERY: Human Eye (Fig. 144). The same technique is observed on the human eye as described for the kitten's eye (Fig. 157).

AUTHOR'S NEEDLE DELIVERY: Kitten's Eye. (Fig. 158). When a lens is to be removed, the author's needle is always held in the left hand while pressure is being made on the cornea with the hook held in the right hand. If vitreous loss is imminent, or has actually occurred, the needle is thrust deeply into the edge of the lens at once without relaxing the pressure of the hook, and a slight motion is made to one side with it, assisting delivery with slight pressure of the hook on the cornea; but the needle is not used if delivery can be safely made without it, because the capsule is sometimes ruptured, and many operators prefer a secondary operation to a loss of vitreous.

If the capsule is ruptured, the lens matter is practically all removed because of the pressure of the hook at the time of rupture.

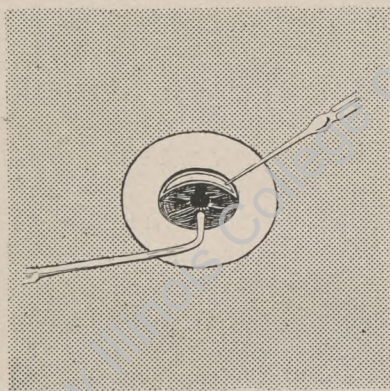


Fig. 153. Author's needle delivery, kitten's eye.

This technique should be emphasized and mastered, because many eyes will be saved that might otherwise be lost. If a cataract operation by any method is not attempted until this technique has been mastered on the kitten's eye, a great step forward in cataract technique will have been made.

AUTHOR'S NEEDLE DELIVERY: Human eye. (Fig. 145). When the cataract refuses to be delivered without excessive pressure, the needle is inserted deeply into the edge of the lens of the human eye in exactly the same manner as described for the kitten's eye (Fig. 158). When the technique of removing a lens in capsule has been mastered, it will seldom be necessary to use the author's needle.

The Smith spoon and the author's needle should be mastered on kittens' eyes in order that they may be used to the best advantage when necessary.

CAPSULOTOMY METHOD: Kitten's Eye. (Fig. 159). If the capsulotomy operation is selected, the capsule may be cut with the capsulotome by passing it into the anterior chamber and cutting the capsule. It will not be necessary to break the zonula to practice lens delivery after the capsule is opened as described (Fig. 152). After the capsule has been ruptured the technique of lens delivery as described (Figs. 153, 131, 154, 134, 155 and 135), will be found desirable. The same technique applies to the human eye.

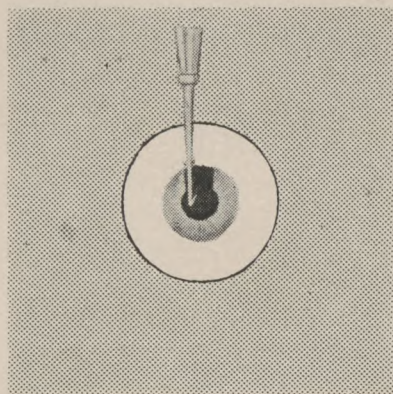


Fig. 159. Capsulotome, kitten's eye.

CAPSULE FORCEPS: Kitten's Eye. (Fig. 160). If the operator desires to use the capsule forceps, it is introduced into the eye closed, then opened, the capsule grasped, and a piece lifted out. The lens can then be delivered in the same manner as described (Figs. 153, 131, 154, 134, 155 and 135), and the toilet made as in Figs. 156 and 136.

The same technique is observed when using the capsule forceps on the human eye as described when operating on the kitten's eye.

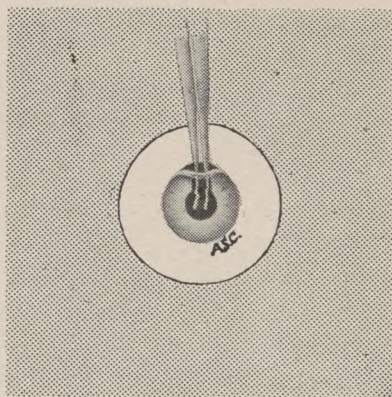


Fig. 160. Capsule forceps, kitten's eye.

AFTER THE TECHNIQUE IS MASTERED ON THE KITTEN'S EYE.

When a sufficient number of kittens have been operated upon to enable one to master the technique of making the incision, iridectomy, lens pressure, toilet, spoon and needle delivery, the operator will approach an operation on the human eye by any method with more confidence than he could possibly obtain in any other manner, except by operating on a large number of human eyes, which would be impossible without a tremendous sacrifice of eyes.

THE ASSISTANT: A competent assistant in a cataract operation is indispensable; to have a good assistant the operator must be able to train him; and to be able to do this he must first make himself a competent assistant.

The special duty of an assistant during a cataract operation is to keep the lids from making pressure on the globe, and this skill can be obtained only by experience and abundance of material.

Anyone who has a few drops of a 2 per cent solution of holocain dropped into his eye two or three times is suitable for practice when placed on a table. The lids held apart as illustrated in Figures 128 and 130, will give the desired result. If the surgeon and his assistant will practice this procedure a sufficient number of times, it will lessen complications, obtain better average vision and will spell success, whatever method of operating is selected. A nurse can be a competent assistant, provided that she has practiced upon a sufficient number of human eyelids to insure proficiency. A nurse is usually complimented by giving her such an important part in the operation, and there is hardly any excuse for an operator to say that he has difficulty in getting a competent assistant. For those who have no opportunity to operate in an ophthalmic hospital, but must operate in general hospitals, or in the patient's home, an office assistant could be made competent if she were sufficiently trained to hold the lid hooks. The real key to an assistant's proficiency is that the surgeon and the assistant make themselves competent by working together on the lids of patients anesthetized for that purpose a sufficient number of times to insure success before attempting a cataract operation by any method. My assistant is usually a nurse.

WHEN SHOULD AN OPERATION BE PERFORMED? A patient having senile cataract of sufficient opacity to prevent attending to his ordinary duties, is considered ready for an operation, provided there is a clean lachrymal sac, lids and conjunctiva, normal tension, and the pupils react to light normally.

After proficiency is obtained by operating on a sufficient number of kittens, and the surgeon and his assistant are both masters of the lid technique, and have gone through a mock operation together a sufficient number of times to be able to know their places, the operation is begun.

Colonel Smith deserves the credit of successfully keeping the lids away from the eyeball while the lens is being delivered, but it is necessary that a speculum be used while making the incision, because the single hook, devised by him, will not hold the upper lid in the best position for making the incision. Smith removes the speculum after the incision and iridectomy has been made, introduces the single hook, and does not remove it until the operation is finished and the lids are closed. Smith deserves the gratitude of mankind for this clever method of holding the lids, which can be used to advantage whichever method is selected, and which has made the intracapsular operation possible. Anyone who has had the pleasure of operating in Smith's clinic in India must be impressed with the method in

use, but he will also be impressed with Smith's skill, as well as that of Nur Ali, his incomparable assistant.

Vail³, Green⁴, Crossley⁵, Fisher⁶ and others have suggested improvements for holding lids away from the eyeball which they believe have special virtues; but the best method may not, as yet, have been developed. The author uses the hooks he has devised, probably because he is more familiar with them than with the others.

VITREOUS LOSS: The loss of vitreous appears to be the one complication that prevents the intracapsular operation from being universally adopted. Fisher⁷, advises the mastering of Smith's spoon delivery and of his needle on the kitten's eyes before attempting the removal of a lens by any method.

Vitreous loss has been and probably always will be considered the most serious complication that can happen when a lens is removed; but, when the operator is prepared to handle such a complication successfully, the danger will be minimized.

If the capsulotomy operation is being performed and vitreous precedes delivery of the lens, the complication is just as grave as though the intracapsular operation had been selected.

If, then, the loss of vitreous is the only thing that prevents competent operators from adopting the intracapsular operation, and that this can be practically eliminated, there seems no good reason why the capsulotomy operation should be

done, because of so many disadvantages when the capsule is left in the eye.

A COMPARISON: The minimum requirement of a barber's school before issuing a certificate of attendance is 1,000 shaves. This does not signify proficiency, but if one must shave one thousand faces as a preliminary for his vocation, why not have one contemplating such a delicate operation as cataract extraction, operate on a sufficient number of kittens' eyes (which should make him quite dexterous), before attempting a cataract operation on the human eye by any method?

VISUAL RESULTS: Space will not permit, and it is not pertinent in this place to give visual results after cataract operations by any particular method; but a comparison of visual results should be interesting. If the intracapsular method produces better visual results than the capsulotomy, it is the one that should have the preference, provided the operation is within the reach of ophthalmic surgeons.

In the United States, Vail^{8, 8}, Knapp², A. S., and L. D. Green⁹, Green, D. W. and Millette¹⁰, Meding¹¹, Fisher^{1, 7, 12}, Pratt¹³, Hallett¹⁴, and others, have reported visual results after the intracapsular method. In their hands the results are superior to those obtained by the capsulotomy method, and the complications are very much less.

From these reports, I am led to believe that the intracapsular operation offers a great many advantages and but few disadvantages, provided

the operator is competent and prepared to handle the complications successfully.

CONCLUSION: The technique of a cataract operation by any method has been considered by many as well nigh impossible except for the favored few, who have access to ample clinical material, and even they will have a great loss of eyes if practice is first obtained only on human eyes.

If the technique of holding the lids can be mastered before a cataract operation is begun and it can; if a kitten's eye furnishes a good substitute for the human eye in making the incision, iridectomy, lens delivery, and toilet, and it does; and if the kitten's eye is a good substitute for the human eye for mastering the complications, and it is, then one can hope to have good results in removing lenses in any manner, provided he operates a sufficient number of times.

If, then, the operator is master of the operation and complications before beginning the operation on the human eye, he can remove a cataract in its capsule at any stage of maturity, and expect better results by operating when his patient can see to go around, than he would be by waiting until he was blind and had lost his nerve and possibly his health.

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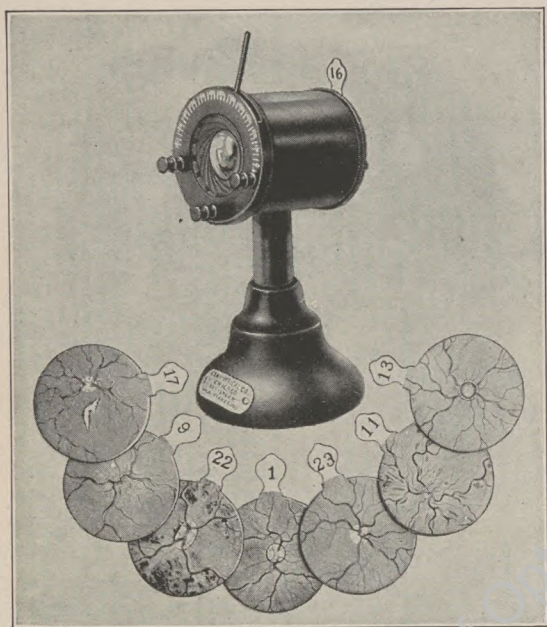
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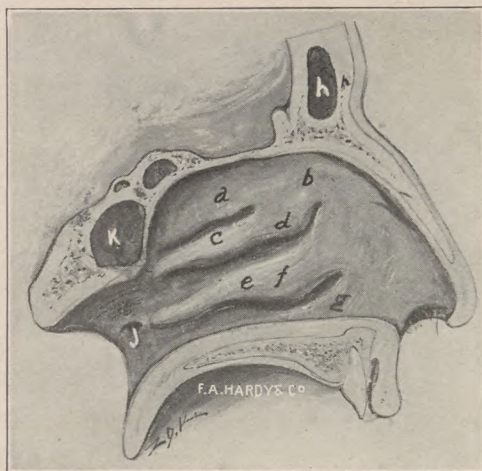
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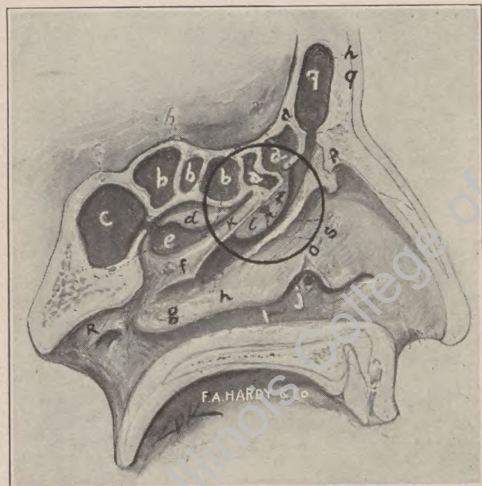
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